

**National Fall
Technical Advisory Group**

**Fall Prevention Equipment &
Technology Resource Guide**

**Prepared by:
VISN 8 Patient Safety Center of Inquiry**

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Fall Equipment & Technology Resource Guide

Patient falls are an issue of great concern to members of the health care community (Cook et al., 1998; Kohn et al., 1999). While patient falls are a problem that extends across the continuum of care, certain patient populations are of special concern (DiBella & Harvey, 1998; National Safety Council, 1999). Among the elderly, falls are the second most common cause of injury deaths and the most common cause of injury visits to the emergency room (Doweiko 2000; Hoskin, 1998). The magnitude of this problem is evident as one-half of nursing home residents and about one third of community dwelling individuals over the age of 65 fall each year (Thapa, et al., 1995).

Falls are generally multi-factorial in nature, a feature that frequently challenges clinicians and administrators to create and implement individualized and successful interventions. All share the goal of providing the necessary care and services to attain or maintain each patient's highest practicable physical, mental, and psychosocial well being in accordance with their comprehensive assessment and plan of care. However, promotion of the highest level of physical functioning, including mobility, may increase the likelihood of patient falls.

In the past restraints have been advocated as measures to reduce fall risk for patients deemed at high risk. However, the use of restraints has been found to produce adverse effects including increased risk for skin breakdown and joint contracture, loss of mobility and independence. Recent literature has shown that bed rails may cause significant injury and death due to entrapments (Braun & Capezuti, 2000; Todd, Ruhl & Gross, 1997). Between 1985 and 1999, 371 entrapments involving hospital beds, mattresses and rails were reported to the FDA. Of these, 228 resulted in deaths, 56 resulted in non-fatal injury and 56 were not injured due to effective caregiver intervention (Hospital Bed Safety Workgroup, 2000).

Physical restraints inhibit an individual's voluntary movement and there are no studies supporting their efficacy in fall or injury prevention (Braun & Capezuti, 2000). Current regulations and guidance promulgated by the Joint Commission for the Accreditation of Health Care Facilities (JCAHO) and Health Care Financing Administration (HCFA) support patient care that minimizes the use of physical restraints in fall prevention and works towards a restraint-free environment across the health care continuum. (USDHHS Surveyor Guidance, 2000; USDHHS Hospital Guidance, 2000).

We have identified a need for guidance in the systematic evaluation and selection of fall preventive equipment and other related technology. This Resource Guide is an attempt to offer such guidance and begin the dialogue on effective technological solutions to fall prevention and management.

This guide provides information on technical resources and alternatives to patient restraints that are designed to reduce patient falls and fall-related injuries. This is not intended to be a comprehensive list of fall-related equipment and product resources, but rather an outline of a systematic approach to identifying the best technological and equipment solutions available for your situation, once your organization has identified the problems to be addressed. No technology should be considered as com-

plete solutions to fall prevention and other fall prevention products and programs complement this resource guide. Approaches to performing computer searches, as well as various helpful links and web sites are found in Appendix A of this guide. These can be used as a starting point for which you can explore the numerous additional resources available to you.

This document is intended for hospital administrators, clinicians, including physicians, nurses, and therapists of all disciplines, equipment committees, construction groups, architectural, biomechanical and engineering firms. We intend to provide information that will aid the user in determining the appropriate technological solution for the situation. Towards that end, this guide plus information from other sources, including clinical experience, can help reduce extrinsic risk factors contributing to falls and fall-related injuries while maximizing patients' freedom, independence and safety.

As clinical practice and technologies advance, more alternatives will become available and the effectiveness of existing solutions will become better known. In the face of these continuous advances, we intend to help equip the user with resources to independently search product information and explore available options that meet individualized patient care plans. We hope that this guide will aid clinicians' problem-solving processes so that they are better able to select the most appropriate currently available technology to meet patient and environmental needs, and take advantage of emergent technologies.

The **Fall Equipment & Technology Resource Guide** is divided into the following sections:

I. Technology & Equipment Evaluation Guidelines—A Team Approach. The importance of an interdisciplinary approach to fall prevention and equipment evaluation. Recommendations for formation of evaluation teams, initiation of information searches for appropriate technology and equipment, analysis of the information obtained, and transferal of that knowledge into practice.

II. Computer Search Information. Guidelines to help in conducting literature searches for fall-related equipment, products, and literature.

III. Current Technologies. Some categories of current fall prevention technologies, the premise behind them, and practical knowledge regarding their usage.

IV. Barriers to Implementation of Technologies. Discusses issues that may present as challenges that need to be addressed to successfully incorporate appropriate technology use into clinical practice.

V. Conclusion. Summation and a brief discussion of the need for stringent testing

procedures in the face of the sophistication of emerging technologies.

We invite you to share your comments, suggestions and additional information about technology and equipment relevant to falls prevention and management with the VISN 8 Patient Safety Center of Inquiry.

Restraint Issues:

Please note that some of the devices listed in this guide may be considered a form of restraint under the U.S. Department of Health and Human Services (DHHS) Surveyor Guidance 2000 definition. A restraint is “any manual method or physical or mechanical device, material, or equipment attached or adjacent to the patient’s body that the individual cannot remove easily and which restricts freedom of movement or normal access to one’s body” (USDHHS Surveyor Guidance, 2000). Under these criteria, care providers must ensure that restraint alternatives have been attempted, and their use documented. The chosen intervention should be the least restrictive possible to ensure patient safety and well being. Every health care provider should be aware of and ensure strict adherence to the facility’s policies and procedures regarding restraints.

I. Technology & Equipment Evaluation Guidelines

Evaluation Team Structuring

We strongly recommend a team approach to evaluation of falls prevention intervention products and technology. Due to the many disciplines and departments involved in the process of implementing new interventions into practice, a single facility-wide, multidisciplinary team is best for evaluation of all fall prevention technology and products. Formation of such a team will facilitate a structured, systematic approach to obtaining information regarding all aspects of the technology's usage. Having a single group available for product evaluation and recommendations within a facility will reduce redundancy and optimize the evaluation process. Members of the team should include a nurse, a rehabilitation therapist, a physician, a risk manager or quality manager, and a health and safety officer. Participation of other professionals, such as an ergonomist or biomechanist should be encouraged if the resources are available.

Due to the nature of the Veteran's Healthcare Network, the organization of a VHA wide, multidisciplinary team for all facilities is feasible. This body could potentially serve as a means of guidance to local facility teams as well as promote the sharing of results system-wide. The setting up of electronic resources such as mail groups or listserves to encourage communication of ideas/solutions among various sites could facilitate the process. While no such network is currently in existence, we support and encourage the development of communication methods among centers. This multi-step approach and scope of evaluation may not be feasible for all facilities, but the basic process may be adapted to an organization of any size and structure.

Preliminary Equipment Evaluation

Prior to undertaking a clinical trial of any intervention, the team should perform preliminary equipment review. The goal of this review is to narrow down technology choices to those most appropriate for the clinical environment in which the equipment is to be used. The first step is to identify current needs or the problems within a given site, characterize the patient population which the intervention is intended to target, and identify that cohort's primary caregiver(s) and their available resources.

The second step is to identify all the products that could be used to perform the desired application in a reasonable and safe manner. For this, it is useful to develop facility criteria for all desired products (See **Table 1** *Criteria for Selection of Fall/Fall Injury Reduction Devices*). Members of your team can then search the literature for appropriate technology and products. (See **Table 2** for *Sources of Information* and **Appendix A** for search strategies.) Once the product types and product lines of interest have been identified, you can request additional information for each from the manufacturers to further narrow your search.

Following an initial review of the product literature to eliminate those products unsuitable for the intended application, the evaluation team can request from

each manufacturer information on any previous or ongoing field trials and laboratory-based equipment evaluations. If the product manufacturer, rather than an outside research facility, has performed the evaluation, you should be alert to the potential for biased or incomplete reporting of findings. Ideally, you should conduct literature searches in both peer reviewed journals and newspaper and industry trade journals for published information about each product.

Local contracting and technical staff should be involved early in the process and may assist with performance or cost of operation measures for both the equipment and manufacturer or distributor. Performance measures considered by this staff include:

- * Special features of the product not offered by comparable products
- * Trade-in considerations
- * Warranty considerations
- * Maintenance requirements and availability
- * Past-performance of equipment and manufacturer/distributor
- * Environmental and energy efficiency considerations

Technical staff may also contact the U.S. Food and Drug Administration (FDA) Center for Devices and Radiological Health (<http://www.fda.gov/cdrh/index.html>), the

Table 1: General Criteria for Selection of Fall and Fall-Related Injury Reduction Technology & Equipment	
1	Appropriate for the task to be accomplished
2	Safe for both the patient and the nurse and other caregivers
3	Comfortable for the patient, does not produce or intensify pain, contribute to bruising of the skin, or tear the skin, nor unduly compromise personal dignity
4	Easily understood and manageable
5	Efficient to use
6	Minimal maintenance
7	Versatile
8	Easily cleaned and with infection control instructions
9	Readily available when needed
10	Cost effective, considering the product life span
11	Compatible with existing systems, i.e., structures, furnishings, alarm and nurse call systems, as appropriate
12	Reusable

Emergency Care Research Institute (ECRI) (<http://www.ecri.org/>), and other consumer information agencies for equipment-related adverse incidents and product recalls.

You may wish to request a list from vendors of their customers as equipment owners may be able to supply very useful evaluation information. If possible, you may wish to conduct site visits at select referred facilities. This would allow the team to view equipment in operation, discuss experiences with facility staff and patients, and obtain cost of operation information. An unstructured form (*Incidents, Maintenance and Adverse Events*) is attached to this document (**Appendix B**) to facilitate note taking on cost of operation. A referred facility might even be willing to provide access to patients and staff for a systematic field study of mutual benefit.

Limited Clinical Trials

Before embarking upon any clinical trial, it is necessary to reduce the number of products to be tested to, ideally, two or three competitive products. Often, due to the specialized nature of the equipment, an effective preliminary equipment evaluation achieves this goal. If the preliminary process yields only one suitable product, and that product appears to reasonably satisfy the task requirements without imposing undue patient or caregiver risk, then the clinical trial need only involve that technology. If the preliminary process identifies several suitable products, the evaluation team may choose to further exclude products based on the criteria below, or on other facility-specific criteria.

How to limit products for further evaluation is an individual decision. Some criteria that you may wish to employ include:

- * best choice based upon the preliminary evaluation
- * most popular based on sales information
- * upper and lower product function extremes – i.e., most basic and most comprehensive products on the market
- * product presents an innovative approach to the task

Often one particular product will satisfy two or more of the above criteria, thereby reducing the overall number of products for trial. The team must establish the maximum number of products that they think are needed to perform an effective limited clinical trial in order to identify the optimum technology / equipment / intervention(s) for a specific population and/or clinical setting.

Inviting equipment vendors to present their products on-site to the entire nursing staff and appropriate patient populations at an 'Equipment Day' exhibition can be most beneficial. Product samples may be set up and demonstrated at this time, facilitating side-by-side comparisons. Nurses and patients should be encouraged to examine and use each product and to provide feedback via a structured evaluation questionnaire, which should elicit their experiences and concerns from the point of view of the needs of patients and providers. **Appen-**

dix B contains some sample evaluation forms, which you can modify to your needs. Information gathered from this event may further aid the team in finalizing a list of products for the clinical trial.

The multidisciplinary Technology and Equipment Evaluation Team, using their preliminary evaluation and pre-selection processes, can then contact identified product manufacturers to provide product samples for on-site clinical evaluations. Most manufacturers are eager to provide a sample for the chance of future sales, however, they may assign a representative to be involved in this process. The manufacturer's representative may try to influence the evaluation protocol, including selection of competitive products. Some of their ideas might be useful and worth listening to, but overall, the evaluation team is responsible for the protocol design.

To begin the limited clinical trials, one or two units are selected. Once the test location is determined, the team identifies various staff members willing to assist with the clinical evaluation process. These staff members should represent multiple disciplines involved in direct patient care. Training should be given on safe equipment usage and proper completion of both the caregiver and patient feedback forms.

A contact person from the site's multi-disciplinary team should be identified and be easily accessible to all participants during the trial. Development of a close working relationship is essential to the success of the trial. Review of the feedback forms with the professionals who completed them will further aid in the process.

This is one approach to organizing a clinical trial of equipment and technology, but it is by no means the only one. Clinical care settings, patient populations, and facilities differ in their needs. The goal of the facility evaluation team is to devise a method that will be best received at a specific trial location. Staff, and sometimes patient, participation and feedback are vital to successful clinical trials that produce useful results.

Purchasing Details

Once a decision has been reached, local contracting staff must be consulted to assist with negotiating the purchase. Since the procurement of fall reduction devices is intended to reduce risk of injury to patients, we have in the past successfully negotiated a guarantee with equipment vendors. You may wish to employ a similar strategy in your own purchase negotiations.

For example, vendors are asked to guarantee that procurement of their product will lead to a certain percentage of reduction in injuries. Anticipated injury reduction may range from 20 percent to 50 percent and is dependent upon the device type and application. If the negotiated injury reduction potential is not achieved within a specified time frame then the contract would call for a purchase refund. We have found that this process achieves many objectives, including capital investment justification to

equipment procurement committees and enhanced after-sales service from the equipment vendor.

Sources of Information

Information may come from a variety of sources, each with unique advantages and disadvantages. (See **Table 2: Sources of Information**.) An evaluation's complexity may be based upon anticipated use and caregiver/patient risk, as well as personnel and other available resources. For example, if a particular product is to be used periodically and the expected caregiver and patient risk is expected to be minimal, then a comprehensive laboratory-based evaluation of competitive products may not be justified.

Product Information	* Rapid assessment	* Biased information
External Evaluations/ Literature Review	* Rapid source of information	* Typically conducted by manufacturer, therefore may be biased
References	* Rapid assessment	* References typically selected by manufacturer * Highly subjective
Field Evaluations/ Clinical Trials	* Caregiver input * Patient input * Moderate timeframe	* Must be comparative, either control or competitive products, to be meaningful
Lab-Based Biomechanics Evaluation	* Comprehensive approach * Objective * Caregiver input * Patient Input	* Time-consuming * Costly * Must be comparative, either control or competitive products, to be meaningful
* An evaluation should include a variety of the above information sources.		

II. Searching and Updating Information

Your team members and other people in your facility should share resources, including catalogues, industry journals, useful research publications, professional organization publications, and effective search strategies. University libraries, as well as public libraries can be helpful in your search for reliable sources of information. Their reference librarians are often a valuable resource, and they are proficient in multiple search strategies.

The widespread availability of online search engines has facilitated the process of information gathering for decision making for everyone. However the maxim *caveat emptor*, let the buyer beware, is particularly relevant to information gathered on the World Wide Web. Manufacturer and distributor websites can be used to rapidly compare products and features, but additional unbiased sources of information should also be consulted.

Appendix A contains a primer on Web-based searching, some search strategies, and a limited number of websites and other resources for information about technology and equipment. This is not meant to be in any way a complete, much less exhaustive list. The areas of patient safety and fall prevention technology and equipment are changing almost daily, with new products and other innovations constantly being developed and disseminated. You should compile a list of products and technologies that are relevant to your needs, and update it periodically as your needs and the technologies change.

III. Current Technologies

As a result of your preliminary evaluation and possibly clinical trials, facility healthcare administrators and providers now have a set of options and resources regarding fall interventions at their disposal. An environment that promotes problem solving and team discussion for dealing with high-risk patients will lead to matching the most effective intervention available to the individualized needs of the patient. In-services, team rounds and staffing are a good forum for developing an organizational culture that promotes these solutions.

Once a high-risk patient has been identified, behaviors surrounding the specific incident (fall or near fall) needs to be evaluated with the goal of identifying its root cause. This process is necessary so that the most appropriate interventions to address this root cause are tried first.

This section summarizes some categories of fall prevention products and technologies that promote a restraint free environment, and provides some practical knowledge regarding their usage.

ASSISTIVE DEVICES

Canes and Walkers. Numerous types of gait devices exist, ranging from simple wooden canes to high-end, wheeled walkers with brakes and seats. There are innovative technologies available, including canes that double as reachers and walkers with “skis” that increase ease of pushing to diminish energy expenditure. Mild to moderate levels of patient unsteadiness may be addressed and compensated with these devices. However, inappropriate use of a walking aid can often worsen gait and can potentiate a fall. Therefore, if one suspects that an assistive device may be beneficial, a referral to physical therapy is recom-



mended for gait assessment, training and issuing of an appropriate walking aid.

Gait Belts. Their primary use is to serve as a “handle” with which the care provider can steady patients who need minor assistance with mobility tasks. Basic, low-end models consist of 2-inch wide cotton webbed belts with a Velcro or buckle closure. More costly versions are generally wider, which some feel gives increased comfort to the patient, are made of heavy-duty nylon and have multiple handles fastened onto the belt. If additional force is required for mobilization of the patient, use of some form of lifting technology should be encouraged to ensure the physical safety of all involved.



Wheelchairs. This category of interventions is ideal for patients who are not strong enough to ambulate but want the freedom to move about independently. To encourage independent propulsion, the chair should be properly fitted by a therapist who is knowledgeable in this area. Factors to consider are chair weight, turning radius for increased maneuverability, seat to floor height (to allow patients to assist with their feet) and seating specifications for optimum comfort and function. The patient's reliability with brake use must be assessed prior to issuing of a chair, as failure of the patient to lock the brakes when transferring may result in a serious fall. Tubular extensions of varying lengths, placed over the brake handles, may improve the patient's access to them, while painting them a bright color can serve as a reminder to use them.

PROTECTIVE DEVICES

Under current guidelines for eliminating or reducing patient restraints and bedrails, patients who are at risk for falls will be able to mobilize more independently. Increased mobility should help patients avoid many complications associated with immobilization, as well as improving their dignity and quality of life. However, increased mobility may result in an increase in the incidence of falls. Products are now available to reduce fall-related injuries and/or their severity. These products are designed with the premise that patients will fall, but the goal is to reduce the likelihood of an injury associated with a fall through the use of these protective devices. Examples of these types of protective devices include hip protectors, helmets, or mats and body pillows that pad of the environment.

Hip Protectors. The majority of hip fractures occur as a result of a fall impact to the greater trochanter. Hip protectors attenuate the fall impact forces on this prominent and therefore vulnerable bone. Clinical trials of various types of hip protectors in nursing homes and the community have been done and are ongoing. The results to date suggest that hip protectors are very effective (up to 100%) in preventing fractures when worn. “When worn” is the operative condition as compliance ranges from fair to poor. The ideal hip protector would mimic customary underwear, to minimize patient resistance to having to wear protection at all.



Three types of hip protectors are currently on the market:

- a. *Rigid Shunting Shell Pads*: These pads divert the impact force away from the hip. They are quite effective, but have compliance issues because of the discomfort of the hard shell. This problem is magnified when used while sleeping.
- b. *Soft Adsorbing Pads*: These pads are made from rubber-like elastomers or visco-elastomers. The pad material absorbs the impact energy. Depending upon their thickness and composition, these pads can be quite effective. Although they are much softer than shell pads, they tend to be thicker. This can adversely affect patient compliance because they make the wearer “look fat.”
- c. *Dual-Mechanism Shunting/Absorbing Pads*: These pads can offer the best features of both types, with an absorbing component and a dispersing component.

Many manufactures suggest having 3-6 pairs per patient depending upon their wearing schedule, continence and hospital washing policy/frequency.

Helmets: With falls being identified as the second leading cause of brain injury in the elderly, helmet use is becoming more prevalent with this population. Various types exist and are predominantly derived from predecessors used in adults with neurological conditions resulting in violent spasms, and to a larger extent with a pediatric clientele. Commonly, helmets are hard shelled with a shock absorbent foam liner. Yet to increase comfort, esthetics and ultimately compliance, many manufacturers have developed lightweight, soft helmets. These generally consist of a core structure with high tensile strength and a high compression/recovery ratio that is built into varying layers of energy absorbing and dissipating materials. They have also become more cosmetically pleasing, with a variety of colors and designs to choose from.

Mats: As the use of bedrails diminishes due to the hazards of entrapment and death, alternatives are being developed. One alternative, which is increasing in popularity, is the use of floor mats next to beds to dissipate forces and protect the patient in the event of a fall out of bed. As with many of the products discussed, there are many manufacturers to choose from. All these mats commonly are covered by a durable, heavy-duty, fire retardant vinyl and have resilient foam filler of varying thicknesses. The heavy vinyl fabrics provide superior resistance against puncture tears and wear from everyday use. Seams are usually compounded with anti-bacterial and anti-fungal agents. While the mats may reduce injuries resulting from falls from bed, their use could potentially increase the risk for both staff and patients from tripping on the edge of the mat. In general, these mats are used for patients who are bed-bound and not those who are ambulatory.

Body Pillows: These products are often placed on the mattress surrounding the patient to provide a soft, protective yet easily removable perimeter of the sleeping surface. Pillows may also be used in positioning the patient for comfort. Some mattresses are available with a build-in bed perimeter thus providing the patient with a reminder of the edge of the bed.

WARNING SYSTEMS

Numerous types of warning systems/alarms are available at this time and are being used successfully in many institutions and community settings. Most alarm systems monitor the patient's position and inform the provider of changes. There are alarms that attach to a bed, a chair and even a toilet seat. Various types of sensor mechanisms are available including those that can be placed either directly under the patient or under the seating surface, e.g., mattress or wheelchair cushion. The advantage to these nylon-covered sensors is that they are imperceptible to the patient and frequently have an adjustable signal time-delay that allows the care provider to program a delay between the unweighting of the sensor and the activating of the alarm. This feature allows for normal patient weight shifting, and therefore reduces the potential for false alarms from the patient merely relieving pressure.



For quality assurance purposes, certain manufacturers have developed monitors that store and create time records. These systems produce an information report, which lists all the times that the alarm went off, and calculates the total number of times the alarm sounded within a given period and the response time for each event.

Other types of sensors used for various alarm systems include infrared beams, mechanical pull cords that are attached to the patient's clothes and units worn by the patient that sense change in spatial orientation. It is important to remember that there are benefits and disadvantages to most of these sensor types and certain sensors may be more appropriate for particular patient populations.

Many of these technologies input into the existing nursing call bell systems, which allows the nursing station to monitor patient movement and quickly respond in the appropriate manner. When others are engaged, they may turn on the lights to illuminate the patient's environment immediately. Some even trigger a message, pre-recorded by the patient's favorite family or staff member, which gently orientates them and encourages them to sit down until assistance arrives. Certain devices allow for a combination of actions to be programmed to occur simultaneously.

Other warning devices available on the market include door alarms and emergency buttons which home dwelling patients can wear around their necks and use to signal that they have fallen while alone and require assistance. Some systems use nursery monitors to allow caregivers to hear when the patient is moving around. With the wide variety of devices available, the health care provider must assess which one is most appropriate for a given patient population.

ADL ASSISTS AND OTHER SPECIALIZED EQUIPMENT

Many falls occur when patients attempt bending or reaching movements associated with performance of Activities of Daily Living (ADLs). In order to promote independ-

ence yet maintain safety, many products allow the patient to perform these ADL tasks yet avoid postures which place them at a high risk for falls. Reachers, sock aids and long handled shoehorns are examples of this type of equipment. These devices minimize the bending and reaching required by the patient in order to successfully complete common tasks independently. Similar products to minimize the balance demands required for bathing are long-handled sponges and hand-held shower hoses.

A major ADL activity, which often results in falls, is toileting, especially during the night or early morning when patients are generally drowsy, disoriented and moving in darkened environments. Use of nightlights has been helpful and motion sensitive lighting is becoming a viable option. Some facilities even use fluorescent tape on the floor to remind the patient where the bathroom is located. If walking to the bathroom presents too great a risk, use of a bedside commode, which requires the patient to simply perform a stand-pivot transfer, may solve the problem yet still allow some independence and control.

TRANSFER AIDS/DEVICES

Instability and an increased likelihood of falls often occur during patient transfers from various surfaces such as beds, chairs, low surfaces, etc. Often, this risk can be diminished with the use of the many transfer aids on the market. A transfer aid is a device that allows the patient to perform the task with increased ease and safety. A transfer aid can often allow a patient to improve his performance from requiring minimal assistance to being independent, thus positively affecting his sense of well-being and self-efficacy.



Examples of bed transfer aids include bed handles, bed ropes or ladders, grab bars, $\frac{1}{4}$ and $\frac{1}{2}$ side rails, transfer poles and overhead trapezes. All of these are some form of bar which attaches to the bed or its surroundings, e.g., the floor or ceiling, to give the patient a handhold with which to pull himself to an upright position. Once upright,

this bar can provide a solid support surface to hold onto until the patient is ready to begin ambulating. Exact positioning of these devices is dependent upon patient presentation, including motor control, ROM, problem solving abilities, etc. Proper installation of these products is essential for safety and some patients may require education and training to ensure their effective use. A sophisticated transfer aid or device as a chairlift may at times be the only option that will allow the patient to stand independently.

Transfer devices also exist for wheelchair users who lack lower extremity strength or the ability to stand. Many variations of sliding boards exist which “bridge” the gap between surfaces thus allowing the patient to gradually move laterally, provided they have sufficient balance and upper extremity strength. In an attempt to increase the ease of such a transfer, various means of decreasing friction between the patient and the board surface have been marketed. Sliding boards with rollers and special friction reducing surfaces are available, as well as nylon materials that serve as a friction-reducing interface that is placed between the patient and board surface.

For dependent or highly impaired patients, manual 1-3 person transfers have always been a potential source of falls and to a larger degree staff injury. While a detailed description of lift systems is beyond the scope of this guide, health care providers need to be familiar with their usage as an assisted transfer performed improperly can result in a patient fall, and a patient and/or provider injury.

SPECIALTY CHAIRS

Not all patients fit in the categories of “ambulators” or active wheelchair users, and it is this other population that often requires staff to discover innovative solutions to optimize their participation in daily activities and quality of life. This category of patients frequently have severe mobility deficits, which can often result in joint contractures and skin problems, postural weakness which makes sitting upright at 90 degrees for a prolonged period difficult, and cognitive involvement which may give rise to behavioral problems. These patients are often restrained and isolated, resulting in perpetuation of this negative behavior and further deconditioning. Many health-care providers are unaware of products that may help with the overall management of these patients. Specialty chairs exist which are lower to the ground and have a longer wheelbase for increased stability. These often come with a rocking or a spring mechanism built into the chair, which allows the patient to perform self-initiated, small amplitude, repetitive movements that can have a soothing and calming affect. Tilt mechanisms are also generally included in these chairs to allow for re-positioning and increased support for patients with impaired trunk control. Lapboards are also available. Despite the many specialized features on these chairs, they are still of appropriate weight to allow caregivers to wheel the patient around and participate in group activities.



Some patients may still not be appropriate for this type of chair due to dependency with regard to mobility tasks and sitting ability. The need to sit these patients up daily has been documented in many resources and is essential for mental stimulation. Referral to a Seating and Mobility Wheelchair Clinic for this population is highly recommended as they often present with multiple medical issues that warrant a specialized seating system. For a permanent wheelchair, a tilt-in-space chair with personalized adaptations can be used. This allows the patient to obtain the lightest chair possible to adequately meet his or her needs, allowing for that important ability to be mobile with assistance. Use of chairs, which do not allow the patient to

move around his environment, is not recommended as it promotes seclusion and minimal social stimulation.

ARCHITECTURAL AIDS

Bathroom: Patient falls frequently occur in bathrooms or while on the way to the bathroom. Due to the large number of falls that occur in this specific area, many products have been developed to optimize safe patient functioning within this environment. Possible adaptations to toilets include elevated seats with or without built-in handrails, frames which may be placed around the toilet that allow for patient handhold, and stationary commodes which are a combination of these devices. Strategically located grab bars may be another option for improving transfer safety. Since many of these devices are meant for patients to bear weight on, there must be adequate means of interface with the environment and proper installation. Ideally, bars and supports should be floor or wall mounted yet in some situations, e.g., a home or apartment, the patient may refuse to allow drilling or other permanent modifications. In that case a free standing or attachable device can be used. Many of these devices are available, and they are generally able to withstand fairly large forces. Bars are primarily made of aluminum or non-corrosive stainless steel with a durable protective coating.

There are various products that facilitate transfer into the tub or shower and alternatives to standing. Bathtub security rails which attach to the rim of the tub are available to improve transfer safety as well as tub benches which are seating surfaces that extend over and into the bathtub, thus eliminating the need to perform the task while standing. In some cases, where the transfer into the bathtub is extremely difficult, architectural alteration from a bathtub to a walk-in shower may be an alternative—although this is an expensive one.

Once in the tub or shower, various types of chairs or benches can be employed to allow the patient to sit during bathing. These products generally have suction cups to avoid movement. Back supports range from none (just a stool) to full support with backrest and armrests for patients with greater balance deficits. As around the toilet, grab bars of varying lengths may be placed at appropriate levels to allow patient support. The use of a hand-held shower hose often allows the patient to wash independently or with reduced assistance. Finally, non-skid bathmats, many with suction cups to secure them to the floor, can diminish the chance of slipping during entry and exit. When dealing with alterations in a patient's home environment, an evaluation by a physical, occupational or kinesiologist is highly recommended, so they can optimize grab bar placement for that patient's condition and assess the need for transfer training.

Handrails: Installation of handrails within patient environments can improve patient safety and reduce falls and injuries. Numerous shapes and sizes exist in addition to various surface coatings and colors. Product lines often include straight, corner or angled bars to accommodate the environment in which they are installed. Corner guards are also available to smooth out rough corner edges in the case of a near fall.

Flooring: Recent research has been published regarding the correlation between incidence of falls, incidence of injurious falls and type of flooring. Some researchers have found a decreased incidence of injurious falls on carpet and postulate that it may be due to shock absorption by the flooring material. However, many patients report a fall from tripping over the edge of a scatter rug. This problem is ideally remedied by removing the rug, yet often patients are strongly opposed to this. Other solutions are the use of double sided carpet tape to affix the rug to the floor or non-slip rug cushions. These are rolls of polyester, mesh fabric with special non-slip coating properties that can be cut to the rug's exact size and placed between the rug and the floor to prevent movement and curling of edges (NOTE: models are specific to underlying surface material). If purchase of new carpet is an option, slip resistant carpet surfaces are available which have gripper treads to avoid slippage between the floor and the carpet.

Carpeting an entire institution is often not feasible due to durability, wear and cleaning issues. Hard flooring surfaces generally provide easier upkeep and wear better over time in high traffic situations. In these cases, implementation of fall intervention procedures are still possible. Anti-slip floor coating may be applied via painting or spraying to underlying wood, metal or concrete flooring (can be used on ramps and steps). Anti-slip, glare reducing acrylic floor wax is another option. New floor coverings are an area of increasing research and development. Slip-resistant nylon surface floor coverings with cushioned vinyl backing are now emerging as potential products for fall intervention. The impact absorbing cushioning is hypothesized to reduce the risk of injury if a fall occurs, with the additional advantages of decreasing glare and absorbing noise, thereby contributing towards a more pleasant environment.

Specialty Furniture: Numerous options are now available in furnishings that are designed to diminish the severity of injury if a fall should occur. A trend towards the replacement of sharp edges with rounded ones can be seen on all types of patient room furniture options.

SPECIALTY BEDS

While a bed perimeter device may decrease fall risk, so may various features of a patient's bed. One problem frequently encountered is inappropriate bed height. Many patients, especially elderly patients, have difficulty transferring in and out of bed because the height is too high or too low. Increasing numbers of healthcare bed manufacturers are developing adjustable height, electric beds which may be positioned as low as 7 7/8 inches from the ground. These beds are typically used for patients who are at risk for falling so that if they do fall out of bed they only fall a short distance, thus minimizing the injury associated with falling out of bed. The advantage of this bed over non-adjustable low beds is that caregivers and support staff can raise the bed's height during patient care activities and cleaning. Many of these beds continue to have head and foot adjustability for



those unable to sleep in a flat position or who must raise their feet for edema control. Furthermore, these beds have lockout mechanisms to prevent inadvertent changes of bed height.

Fully electric and adjustable beds can be costly. To make these products more affordable, semi-electric height-adjustable beds have appeared on the market. These beds allow one adjustment to be controlled electrically but require the other to be altered manually. Brakes on medical equipment are notorious for failure. In response to this problem, central wheel locking systems have been developed which raise the casters off the floor thereby leaving the bed immobile.

Placement of the bed against a wall is useful in controlling the side a patient can get out, thus forcing the patient to use the side of the bed on which a floor mat has been placed. Some newer beds are manufactured with transfer assist devices and transfer poles to assist patients who can get out of bed themselves. As the use of side rails becomes less common, it is expected that these bed transfer poles will become more common for assisting patients to get into or out of bed and turn or reposition while in bed.

When all alternatives have been unsuccessful, placement of the mattress directly on the floor may be the only means possible to diminish risk of injurious falls. However, this is not recommended due to the increased risk of musculoskeletal injuries for caregivers as they bend over and kneel to provide direct patient care.

DIVERSIONAL AND STRUCTURED ACTIVITIES

While goal of this guide is to aid in identifying appropriate and available fall prevention technologies, a discussion regarding the need for structured, scheduled activities and availability of diversion options is essential. No fall prevention program would be complete without addressing the issue of exercise and the importance of its role. Participation in general exercise classes and walking programs should be encouraged in all patients who can benefit. The benefits of exercise in fall prevention is well documented (Tennstedt, Peterson, et al., 1998; Howland, et al., 1998; Tideiksaar, 1997). Some patients require specialized exercise programs, such as Tai Chi, others can benefit from group wellness programs to improve their strength and balance. If the patient needs more intense or individual attention is required, he can be referred to a rehabilitation program.

Many patients who end up being restrained are confused, agitated and restless. Often, this behavior is the result of an unmet psychosocial needs and seclusion will frequently perpetuate this problem. Availability of diversion groups or activities often helps calm the patient and break this behavior cycle. Some patients may sense feelings of uselessness and giving them "jobs" such as folding towels or stuffing envelopes may fulfill this need. Others may respond better to independent activities or use of devices that maintain their attention. This is a very individual process, and activities that are successful often relate to their past social roles or hobbies. Exploratory aprons are garments with multiple activities which keeps the patient occupied. Some individuals may be calmed by music or talking books on tape. The possibilities are

endless and having various options at the staff's disposal is highly beneficial.

IV. Barriers to Implementation of Technologies

Deciding which technologies to utilize in your fall prevention program is only the first step in their successful incorporation into clinical practice. The implementation process has multiple potential barriers that need to be overcome, including patient and provider acceptance of the technology, ongoing maintenance issues and organizational financial concerns.

PATIENT ACCEPTANCE OF TECHNOLOGY

Many health care providers have encountered patients who do not use the assistive technology they have been provided. Many issues lie at the root cause of this problem. Firstly, in order to improve patient acceptance, a health care worker familiar to the patient should be involved with the discussion and instruction regarding the technology. This familiarity generally increases the individual's level of trust and willingness to experiment with new ideas. Secondly, appropriate training and follow-up is needed, as many of these devices require more than a simple, initial training session. Organization of 2-3 short training sessions may optimize patient acceptance by allowing them to use the device and return to the provider at which time their concerns and problems may be addressed. At this follow-up, the provider can ensure the technology is being utilized appropriately, as inappropriate usage can easily lead to the very event that the device was designed to prevent. You can reduce this risk by including the patient's family and caregiver in the training process.

Consideration of the patient's impairments in a holistic manner prior to final decision-making regarding a specific technology also plays a vital role in patient acceptance. Many devices are designed to allow the patient to compensate for a given deficit by other strengths or strategies. However, the patient's condition or co-morbidities may also affect these means of compensation. This resulting mismatch can discourage patient use of the device and in the worst cases, may cause an adverse event. It is imperative that the health care provider be sensitive to all the patient's needs and capabilities and match a device appropriately. A strong working knowledge of the constantly changing field of available technology is required to do this. Often, a specific type of technology may be available with different features from different companies that better suit the needs of a specific patient population.

Lastly, patient dignity and pride must be factored into this equation. Clinicians must be sensitive to issues of esthetics and self-image and how they affect patient acceptance of a given device.

STAFF/PROVIDER ACCEPTANCE OF TECHNOLOGY

Many technologies directly affect caregiver workload and procedure. Consideration of these issues is paramount when deciding upon which specific technologies to purchase. It is for this reason that provider feedback and involvement in the evaluation, purchasing and implementation process is essential. As with patients, adequate training and ongoing support will facilitate provider acceptance of a technology in any setting. Readily

available training materials (brochures, videos) which may be accessed at all times as well as the availability of technical support services will encourage staff to problem solve thru difficulties.

MAINTENANCE ISSUES

As mentioned in the first section, Technology and Equipment Evaluation Guidelines, maintenance issues need to be addressed and factored in prior to equipment purchase. Facility administration should establish channels and means for patients and providers to report problems with a specific device. Additionally, resources and procedures for replacement or issuing of a temporary “loaner” should be addressed.

FINANCIAL BARRIERS

No discussion regarding barriers to implementation of technologies would be complete without the acknowledgement of political and financial obstacles. This is where research, long term product outcomes and cost analysis comes into play. With the shift in healthcare towards tertiary and preventative intervention programs, this barrier is gradually shrinking in size. Policy makers are now understanding that while the purchasing of these technologies are often costly initially, their effect on overall reduction in caregiver burden and avoidance of adverse events results in an ultimate cost savings.

V. CONCLUSION

Technology to reduce the hazards associated with falling for the elderly population has improved over the years. The categories of this technology include restraint free devices such as ambulatory aids, transfer aids, protective devices, warning systems, safety hand rails, transfer benches, shower seats and specialized devices for activities of daily living. Some of these technologies attempt to decrease falls incidence by diminishing extrinsic risk factors in the environment, while others are designed to reduce severity of fall-related injuries.

While striving for independence of the elderly, we must consider the safety of both the patient and the caregiver. New devices should be tested prior to usage, creating a need for mechanisms that anticipate potential adverse health consequences of these technologies. Selection criteria is significant and testing of new devices in the laboratory, use of statistical models to predict hazards, and surveillance systems measuring worker morbidity and mortality associated with new tools, processes or materials may prove beneficial. The stringency of these testing mechanisms are essential in the face of the fast-paced medical equipment marketplace and the sophistication of the potential future emerging technologies.

Robotics is emerging as a technology that may be used in future fall prevention and general safety, e.g., to remind a patient to perform simple tasks that could reduce danger, for example, use a cane or turn off the stove. Robots could also be utilized as an assistive hand in helping patients when transferring from a seated to a standing position.

In current or future technologies, the key to the effective use of a given device within any clinical setting is a good understanding of both the barriers and strengths of the patient

environment, the provider and the patient. With this knowledge, an optimal technological match to the patient care situation can be found.

We believe that an interdisciplinary approach is the most effective strategy to fall prevention and management, including selection of appropriate technological and equipment. Our ultimate goal is to create a safe nurturing environment which respects patients needs and freedoms and results in a high level of quality of life and patient and provider satisfaction.

Appendix A

COMPUTER SEARCHES

Getting Started

For a good primer on web surfing and doing World Wide Web searches, one good option is <http://howto.yahoo.com>. On this page you can see what your options are, and help define your search strategies.

Beginning Your Search

Choose your favorite search engine. If you don't have one, follow along with our instructions for Yahoo!

Go to <http://www.yahoo.com> or <http://howto.yahoo.com>

Key Word Search

Most web searches use the following syntax. If it doesn't work with your browser, go to their search page and click on help, it should show you all of your syntax options.

SYNTAX:

- * Use quotation marks around words that are part of a phrase (i.e. "great barrier reef")
- * Specify words that must appear in the results. Attach a + in front of words that must appear in result documents (i.e. apple +pie)
- * Specify words that should not appear in the results. Attach a - in front of words that must not appear in result documents (i.e. monty -python)

Google

Whenever you enter a search on Yahoo!, the results can come not only from the Yahoo! index, but also from the index of their search partner, Google.

- * If sites related to your search are found within the Yahoo! index, they will be listed under the Categories and/or Web Sites headings (found on the toolbar just above the top search result).
- * If sites related to your search are found within the Google index, they will be listed under the Web Pages heading.
- * The Yahoo! Directory is a manually created, browsable (and searchable) collection of site listings aggregated by human editors, whereas Google is a completely automated search engine: a robot or spider (computer program) automatically crawls the Web, capturing every word on every page crawled. This is an important distinction, as these different search mechanisms can result in different listings of relevant sites. If your search strategy is not successful, it can be useful to

repeat your search terms in different type of search engine.

- * To use Google directly, you can just go to <http://www.google.com> and click on "Advanced Search."

The following terms are some to get you started. Depending on the item you are looking for, and what search engine you use, your results will differ. We do not list specific sites here as they change on a day-to-day basis, and we feel that it is in your best interest to seek this information on an as-needed basis.

- * Accessibility
- * Ambulation aids
- * Assistive clothing
- * Assistive devices
- * Ergonomics
- * Gait training
- * Lifts & ramps
- * Mobility devices
- * Passive motion
- * Safety rails
- * Transfer aids

ADDITIONAL RESOURCES AND SOURCES OF INFORMATION

The following sources of information are included for those who desire further current resources on issues involving patient falls related technologies. This list is not all-inclusive; many more resources exist.

Useful Websites:

Access to the RN+ Systems Fall Prevention and Restraint Reduction newsletter
<http://www.rnplus.com/newsletter.html>

Agency for Healthcare Research and Quality
<http://www.ahrq.gov/>

VISN 8 Patient Safety Center of Inquiry (<http://www.patientsafetycenter.com/>) Safe Patient Handling and Movement Technology Resource Guide web page offers information and links concerning a variety of products to enhance patient safety in the home and hospital environment.
<http://www.patientsafetycenter.com/Safe%20Patient%20Movement%20-%20Tech%20Resource%20Guide/Tech%20Resource%20Guide.htm>

National Guideline Clearinghouse™ (NGC), a public resource for evidence-based clinical practice guidelines.

http://www.guideline.gov/body_home_nf.asp?view=home

Helpful links:

Posters presented in February 2000 at the VHA National Rehab R&D meeting:

<http://guide.stanford.edu/2ndVA/posters.html>

The IBM Patents Server, a source for corporate technologies

<http://patent.womplex.ibm.com/>

Journals and Books:

"Elder Design" is a guidebook for families re products and technologies to make home environment safe. Author: Rosemary Bakker, published in 1997 by Penguin books. Rosemary Bakker, MS, ASID is a Research Associate at Cornell Medical Center in NY.

"Restrain-Free Care: Individualized Approaches for Frail Elders"

Neville E. Strumpf, Joanne E. Patterson, Joan Wagner / Hardcover / Springer Publishing Company, Incorporated / October 1998

"The Encyclopedia of Elder Care: The Comprehensive Resource on Geriatric and Social Care" Mathy Doval Mezey, Terry Fulmer, Barbara J. Berkman (Editor), Christopher M. Callahan (Editor) / Hardcover / Springer Publishing Company, Incorporated / November 2000

Other National Organization's Websites of Interest:

Below you will find the web addresses of some national organizations. These sites often have updated research on falls, fall prevention and conferences announcements of potential interest.

US Food and Drug Administration (FDA) Center for Devices and Radiological Health-

<http://www.fda.gov/cdrh/index.html>

Center for Disease Control (CDC)

<http://www.cdc.gov/>

American Association of Retired Persons (AARP)

<http://www.AARP.org/>

National Patient Safety Foundation

<http://www.ama-assn.org/med-sci/npsf/main.htm>

National Institutes of Health (NIH)

<http://www.NIH.gov>

American Nurses Association (ANA)
<http://www.ana.org/>

American Hospital Association (AHA)
<http://www.aha.org/index.asp>

Appendix B

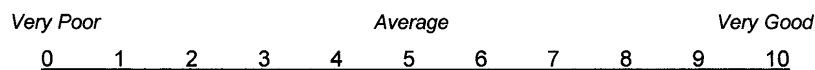
PRODUCT FEATURE RATING SURVEY – CAREGIVER /PROVIDER

Caregiver : _____	Product : _____	Date _____
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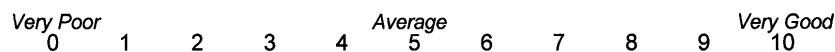
This questionnaire examines ONLY the product that you have just used. Please rate each of the following design features on a scale from 0 to 10, by placing a mark along the line, where 0 indicates a very poor design and 10 indicates a very well designed feature.

We would also appreciate any ideas you may have for improving the product design. Please make your comments alongside the appropriate feature rating, or overleaf if more space is required.

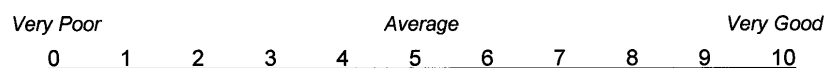
1. Overall Comfort



2. Overall Ease-Of-Use



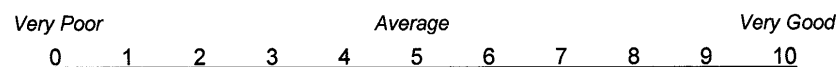
3. Stability



4. Durability



5. Versatility



6. Features you like most about this product:

7. Features you like least about this product:

8. Other Comments: _____

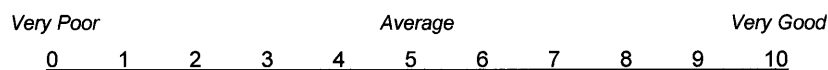
PRODUCT FEATURE RATING SURVEY - PATIENT

Patient : _____	Product : _____	Date _____
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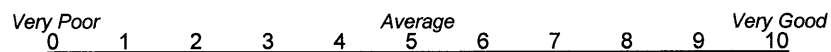
This questionnaire examines ONLY the product that you have just used. Please rate each of the following design features on a scale from 0 to 10, by placing a mark along the line, where 0 indicates a very poor design and 10 indicates a very well designed feature.

We would also appreciate any ideas you may have for improving the product design. Please make your comments alongside the appropriate feature rating, or overleaf if more space is required.

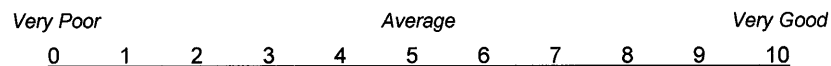
1. Overall Comfort



2. Security



3. Safety



4. Features you like most about this product:

5. Features you like least about this product:

6. Comments: _____

INCIDENTS / MAINTENANCE / ADVERSE EVENTS

Product: _____

Overall Product Effect on Outcome/Quality of Care:

Maintenance Issues:

Adverse Patient Events:

Adverse Provider Events:

Storage Requirements:

Compliance Issues (Patient and Provider):

Good Product Features:

Challenging Product Features:

Appendix C

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