The Human Factors of Home Health Care: A Conceptual Model for Examining Safety and Quality Concerns

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Objective: Increases in longevity, a growing elderly population, variation of skill and knowledge among home providers, and a steady migration of medical devices and technologies into the home are placing new demands on home health care. The paper examines the human factors challenges associated with these converging trends.

Methods: A growing literature base relevant to home health care is examined, and with the aid of a socio-technical systems model, the paper explores safety and quality concerns to which the converging trends are likely to give rise.

Findings: The sensory, physical, and cognitive limitations of patients and their caregivers play a key role in the ability of patients to manage home health care needs. Other major components affecting successful home health care management are the nature of health care tasks undertaken, the design features of the physical environment, the medical devices and technologies used, the social and community environments, and distal but relevant external factors that shape the context of care. Home health care stakeholders can avoid foreseeable threats to safety and quality by recognizing that components need to be designed in a way that takes into account their interactions with one another and with the capabilities and limitations of patients and their providers.

Conclusions: By examining the major components and interdependencies of the home health care delivery system, a human factors perspective offers insights into ways that safety and quality can be compromised and can help pave the way for new models of thinking in home health care policy.

Key Words: human factors, home health care, conceptual model, safety, quality of care

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A number of converging trends have started to focus attention on a complex web of human factor challenges associated with the increasing migration of medical devices, technologies, and care practices into the home. People are living longer, and the aging population with multiple chronic and acute care needs is placing new demands on home health care. No longer solely a private residence, the home increasingly is serving as a place where medical monitoring and therapies are undertaken and as a provider workplace. However, homes have not been designed for the delivery of health care. Considerable variation exists as to what constitutes a home. Both patients and their caregivers may be vulnerable when it comes to receiving and administering care in a safe and reliable manner. Currently, there is very little in the way of evidence, guidance, or oversight processes that address the challenges of these converging trends in the growing home health care sector.

One of the beneficial consequences of the To Err is Human report is that it exposed a wide audience of health services researchers and practitioners to systems and human factors concepts to which they might not otherwise have been exposed. Human factors is the discipline that takes into account human capabilities and limitations in the design of interactive systems of people, tools, technology, and work environments to ensure their safety, effectiveness, and ease of use. With respect to inpatient care, both health care and human factors practitioners have started to venture beyond their own traditional boundaries, working together in teams and benefiting from the sharing of new perspectives and clinical knowledge. There is reason to believe that these helpful partnerships can be applied to home health care as well.

The purpose of the paper is to examine the human factors challenges associated with the converging trends in the home health care sector. With the aid of a socio-technical systems model, safety and quality of care concerns are examined to which these trends give rise. A secondary purpose, from a policy perspective, is to raise awareness and stimulate some critical thinking about the issues.

CONVERGING TRENDS

Sound preventive health practices and therapeutic advances are enabling a segment of the over 65 age group and the aging baby boom generation to continue careers, seek alternative pursuits, and lead healthy, active lives in their communities. Many intend to stay in their homes as long as possible, maintain harmonious relationships with their surroundings, and age in place with dignity. Increases in longevity are accompanied by increases in chronic conditions that require management in the home and attention from community health services.

Economic forces are such that hospital stays are shorter. Patients can be discharged while not fully recovered. Many surgeries are performed in outpatient facilities. Homebound patients frequently have mobility and balance impairments, have surgical wounds that require attention, need to adhere closely to medication regimens, and follow through with respiratory and infusion therapies. Premature discharge and inadequate preparation of the home for continuing therapy can sometimes shift recovery to a sudden need for hospital readmission.

At the same time within the past decade, there has been an increasing movement of sophisticated medical devices and equipment—originally designed for use in hospitals and clinics by trained personnel—into the home. Safe device use in the home is an issue not only from a traditional human factors perspective of user-device interface incompatibilities but also because of challenges associated with patients who are aged and likely sicker as a result of shorter hospital stays. Adequate assessment of the capability of lay caregivers (also likely to be aged) and the suitability of the home environment for device operation and maintenance is likely to be lacking. While vendors of new home
technologies (e.g., assistive devices, telehealth monitoring, robotic systems, health informatics) have been quick to tout the benefits of their products for an aging population, moving at a more glacial pace is consensus on a host of policy-related and operational issues that focus on cost and reimbursement, privacy and data protections, reliability and service, clinical effectiveness, and safety and quality concerns. Considerable variation exists among patients and their home care providers in terms of knowledge, skills, abilities, and willingness to manage a complex array of new technological and medical procedures. In addition to improvements to safety, health care researchers have learned that new technologies and devices can usher in new sources of confusion and error. More than technical considerations need to be taken into account for successful implementation. Given that patients and providers are likely to have sensory, physical, and cognitive impairments to varying degrees, finding the appropriate match among patients and providers, the care-related tasks they will be expected to perform, and the technologies and devices suitable for their use is not so simple. This matching of human capabilities with appropriate care-related tasks with just-the-right technology increasingly will be an individual home health care challenge.

A CONCEPTUAL MODEL

Safe and high-quality home health care depends on a host of factors and their interactions. Figure 1 shows several major factors that need to be examined, adapted from an earlier formulation of socio-technical factors that contributed to adverse events in a complex treatment setting. As a socio-technical systems model, changes in any of the components likely will have repercussions on other components of the system. Focusing on the way these components interact is just as important as the components themselves. When the components interact and function well together, it is reasonable to expect that adverse events are kept to a minimum, and good quality care is provided. When there are weaknesses within the components or they are designed in a way that does not take into account the other components with which they interact, preventable adverse events are more likely to occur. Reason’s Swiss cheese metaphor, well known to patient safety investigators, has been used to illustrate how the weaknesses or holes in the various components and safeguards designed to preclude adverse events (referred to as successive slices of Swiss cheese) can allow themselves and allow hazards to result in actual harm to patients. In the home care setting, it is likewise suspected that adverse events and poor quality care result from the unfortunate alignment of several necessary but singly insufficient factors as found in Figure 1.

The distinction made between latent conditions and active errors, shown along the left margin of Figure 1, is important. Active errors and adverse events are likely to be made by lay and professional caregivers who are responding to the immediate needs of the patient, the so-called sharp end. Latent conditions are the potential contributing factors that lie dormant in the home care delivery system. They occur further upstream at the more remote tiers in the figure, far removed from caregivers who perform at the sharp end. These latent conditions, dubbed the blunt end, are frequently described—whether design refers to the layout of the physical environment, the user interface of medical devices, or the friendliness of the social environment in promoting healthy activities. It is likely to be the patients and their caregivers who inherit the sins of omission and commission of everyone else who has played a role in the design of the home care delivery system. Because home health care tasks tend to be interwoven with other household activities, the design aspects of home health care delivery might be masked or less obvious. Although patients, providers, and home health care agencies might not be fully aware of the design aspects to the way home health care tasks are carried out, the design aspects surely will exert their impact.

Understanding Patient Characteristics and Needs

"Know thy user" is a foremost commandment in the human factors community, and thus, the first tier in Figure 1 indicates that it is important to know something about the range of physical, sensory, and cognitive capabilities and limitations that exist among those attempting to manage their own care. The range of patients that require home health care is considerable. It includes individuals with multiple chronic conditions, acute illnesses, and rehabilitative needs as well as those with unique needs at both ends of the life span continuum—from frailty newborns to the terminally ill. Health literacy and knowledge of one’s own medical needs are patient factors that have important implications for successful self-care functioning. Other important patient factors include visual and auditory acuity; ambulation/locomotion; medication management and infection control capability; and ability to use assistive devices and technologies and engage in infusion and respiratory therapies. Speech and ability to communicate becomes critical when calls for outside help are needed. Motivation and willingness to engage in health care self-management activities are very important. Many elderly people live alone; have limited interactions with others; and silently experience the impact of depression, anxiety, or unsubstantiated beliefs with respect to their own care needs.

In households receiving Medicare-reimbursed services through certified home health agencies, the health and functional status of homebound patients can be assessed by a core set of data items. Developed for the Centers of Medicare & Medicaid Services by the University of Colorado Health Sciences Center, the Center for Health Services Research, the Outcome and Assessment Information Set (OASIS) is designed to have utility for clinical assessment, care planning, and outcome monitoring. Information sought includes the patient’s recent medical history, living and supportive assistance arrangements, status with respect to sensory and cognitive impairments, healing of skin lesions and open wounds, respiratory and swallowing difficulties, and capability to manage oral medications and equipment (e.g., oxygen, intravenous infusion therapy). The OASIS instrument also enables an understanding of a range of activities of daily living (e.g., dressing, feeding, toileting, and bathing) and instrumental activities of daily living (e.g., medications, meal preparation, housekeeping, laundry, finances, and shopping). Further understanding can be acquired from the analyses of patient safety adverse events (e.g., falls, accidents, medication errors, and bloodstream infections) found in OASIS data sets and other sources addressing complexities in the home care environment. Although the use of OASIS associated data sets and Web sites like Medicare’s Home Health Compare can provide useful indicators of threats to patient safety and quality, they are not designed to address full range of risk factors and vulnerabilities found in Figure 1.

Understanding Provider Characteristics and Needs

The second tier of Figure 1 shows there is a similar need to understand the capabilities and limitations of home health care providers and home care aides. With respect to home care workers employed by various service agencies, a distinction is
made between home health care providers who attend to the skilled nursing and health care needs of patients and are generally employed by Medicare-certified agencies and home care aides who attend to housekeeping services (e.g., meal preparation, laundry, shopping, and transportation for medical appointments). Given the generally unsupervised nature of the home environment, there is bound to be some overlap with respect to the functions and tasks that these two groups perform. The home care aide group recently has come under scrutiny in a growing number of home abuse cases (e.g., theft, fraud, and neglect). Considerable variation of knowledge and skill between and within these groups is likely to exist. Because both groups are among the fastest growing occupations in the U.S. labor market, it is important to gain a better sense of the screening mechanisms that are used to determine the entry-level skills, knowledge and qualifications of the two groups. Will these groups have the nuanced understanding to manage the complex chronic and post-acute care needs of the growing elderly population? Many home health providers and aides are reaching their own senior years with their own clusters of physical, sensory, and cognitive limitations. Communication challenges frequently exist for those for whom English is a

FIGURE 1. Contributing factors to safety and quality in home health care.
second language. Little is known about the capability of home health care providers in assisting with the operation, troubleshooting, and maintenance of a variety of medical devices. 

Inattention to the hazards of home health care is apparent when care providers evaluate the patient's home living environment. If not properly addressed, hazards such as falls, slips, and equipment-related injuries can lead to serious complications and may even cause death. The design of the home environment can be a significant factor in determining patient safety and the effectiveness of home health care delivery. 

Provider Tasks and Medical Procedures

Gaining a sound understanding of the tasks and procedures performed in demanding environments is a central human factors concern. Behavioral and cognitive task analysis methods have been devised for this purpose. The tier of Figure 1 underscores the need to understand the nature of home health care tasks, care practices, and medical therapies that are occurring with greater frequency in the home. A considerable range of activities can be anticipated: coaching in self-help skills; lifting and assisting with ambulation; helping with medication management; monitoring of signs and symptoms; ensuring the operation and maintenance of an assortment of devices and technologies that may or may not have been designed for home use; and assisting with dialysis, chemotherapy, and respiratory and infusion procedures, formerly limited to the inpatient setting. 

Skin lesions, open wounds, and pressure ulcers need to be attended to, problems with elimination checked, and changes in affect and behavioral status detected.

Impact of the Physical Environment

There is an emerging evidence base from health care architecture, interior design, environmental psychology, and related disciplines—collectively known as evidence-based health care design—that focuses on the physical environment and how its design can facilitate or impede the safety and quality of care of patients and the work-life quality of providers. The physical environment is represented in tier 4 of Figure 1. While much of the research pertains to inpatient settings, there is a need to apply evidence-based health care design findings, universal design principles, and other usability practices to the home environment. Some of these practices entail intelligent use of space for improved mobility and reduced stress, floor floor adaptations (e.g., bedroom/bathroom), affordances for ease of use (e.g., step-in showers), elevator/airlift systems, information display and telemonitoring systems, automated shelving, variable height countertops, wide door widths, passageways and ramps, ergonomic considerations given to portability, placement and storage of equipment, adjustable and reclined furniture, adjustable height toilet seats, no step entrances, and level access to green areas (e.g., gardens and patio).

The aging-in-place preferences of older residents have not been lost on planners and builders of new and remodeled construction. They envision an expanding market for more adaptable housing as an educated boomer population turns 65 in 2011. They also recognize that the usability benefits of universal design accrue not just to the elderly, or to sick children, disabled adults, or veterans recovering from injuries, but to everyone regardless of age and physical condition. Assisted living quarters and nursing homes also have adopted new design concepts for continued semi-independent living that incorporate many adaptable, home-like qualities.

Yet, another dimension to the home environment needs to be recognized and respected. A home is more than a physical structure. For many, it is where familiar surroundings trigger memories that provide comfort; where personal histories and a sense of place are established; and where the simple joys of daily living stem from interactions with pets, family, neighbors, and the community at large. An important human factors design challenge is that of retaining the joys and comforts of the home while creating affordances for improved self-care management and eliminating hazards that cause harm.

Devices, New Technologies, and Flawed Mental Models

Technological advances are merging with demographic trends and economic pressures to suggest a continued and rapid proliferation of new devices and technologies for home use. The increasing use of dialysis equipment, infusion pumps, and health information technology (IT) underlines a host of patient safety and liability concerns. In the absence of adequate regulatory oversight, the sage advice is caveat emptor. The insertion of new technologies in any setting can be a double-edge sword but
especially in the home environment. Although new technologies offer promise for improved quality of life and sizeable cost savings for third-party payers, they come with challenges that are frequently unappreciated and not thought through carefully. New devices and technologies typically alter workflow and care processes. They require new learning on the part of patients and their providers. With respect to health information technology, purchasers and users do not always understand the technology, its installation requirements, needed privacy standards, and processes for collecting, transmitting and analyzing patient data in an accurate and timely manner. Will the vendor be available when it comes to installation issues, system anomalies, or malfunctioning components? As with any technology, unanticipated problems and lack of adequate service support can lead to frustration, ineffective use, and abandonment of the equipment altogether.

Safe and proper device use has remained a serious patient safety challenge among trained providers in supervised inpatient settings. Now with the shift of care to the home, the human factors challenges become magnified as a consequence of the variable and largely unsupervised home care environment. Standards that have been developed for the design of user interfaces of medical devices and equipment are based on data collected from able-bodied individuals, not those with varying clusters of physical, sensory, and cognitive limitations. A related yet different set of challenges exists at the opposite end of the age spectrum, given the increasing survival rates and complex care needs of vulnerable infants and children. After successful treatment in neonatal and pediatric intensive care units, these patients face the risk of discharge into outpatient and home environments inadequately prepared to handle their special and more intensive needs.

It is common for providers to encounter devices in homes that they have not seen before, that have not been designed for home use, and that have no accompanying documentation or user's manual. When problems arise with the device, there is no bioengineering department to call or knowledgeable colleague to contact as one might do in a hospital setting. Given the opaque nature of many computerized devices, it is not unusual for providers to have an incomplete understanding or flawed mental model of the actual functionality of the device. Flawed mental models exact their toll when the device malfunctions. With a flawed mental model of device operation, the malfunction remains a mystery. If home health providers cannot readily ascertain a device's underlying functionality, they will not be able to take swift, appropriate action that may be critical to patient care when a device malfunctions. The challenge for designers is to create user-device interfaces that promote the formation of appropriate mental models and facilitate meaningful dialogue between user and the device. An extensive review of barriers and drivers of health IT use in elderly, chronically ill, and underserved populations found that the users' perceived benefit of using the system was a common factor influencing successful use. To have a positive impact on health outcomes, the review also found that health IT systems need to include patients in a feedback loop that monitors their status, interprets data in the context of their individualized treatment goals, adjusts the management plan as needed, provides tailored advice back to the patient, and repeats this cycle at appropriate intervals.

Ideally, it should be possible to "medicalize" the home gracefully so that devices and technologies are embedded or re-occur naturally into the background of the home, serving the home occupant as needed while enabling the continued enjoyment of normal, everyday activities. Despite manufacturers' assertions about ease of use of their products, it is not unusual to find multiple steps, substeps, and buried routines when devices are subjected to human factor testing and evaluation. More than traditional usability testing by able-bodied individuals under well-lit, laboratory conditions is needed if a device is to function well in the variable conditions of the home environment. Testing in the environment of use and performing in-depth user and home assessments can reveal a host of problems not anticipated by designers and standard forms of usability testing. Cramped quarters, widely dispersed electrical outlets, and power outages are a few of the contextual factors that impede effective device use in the home.

The "learning curve" associated with proficient device use often goes unrecognized by vendors, home health agencies, and third-party payers. Proficiency takes practice, yet few providers receive adequate training or practice sessions before using devices with patients. Greater use and evaluation of simulated sessions, embedded tutorials, performance prompts, checklists, and criterion-based assessments are needed. In brief, the manner by which individuals are introduced to devices and technologies is likely to have a direct impact on initial acceptability and eventual successful use. Many device and technology adoption problems can be avoided by taking into account the unique conditions of the home, the variable capabilities of patients and caregivers, the need for home and user assessments before installation and implementation, and opportunities for learning and performance support.

Cultural, Social, and Community Environments

Home health care involves more than the care processes and medical therapies that take place within the home. Just as an underlying system of beliefs and shared values shapes organizational culture, there also exists a set of beliefs and accepted ways of doing things that tacitly guide the behavior of the family unit that results in its home or household culture. Individual home cultures influence what home care strategies get adopted, what caregiver roles are assumed, and what ways caregiver tasks are carried out. Not all family traditions and ingrained habits are conducive to health promotion as they may involve unsubstantiated fears and beliefs and questionable routines regarding diet, substances, exercise, and hygiene that are subtly and mutually reinforced within the family unit.

Home health care also involves support and benefits that stem from social settings, activity friendly environments, and a range of community services that further enable independent living. An underlying premise is that the cues and prompts that individuals pick up from others in social settings and activity-friendly environments serve to promote physical activity and healthier lifestyles. The home is an inextricable part of the neighborhood and community in which it is located. The ability to safely navigate one's neighborhood and access the resources in the community is considered an important self-management factor. Neighborhood design features such as the presence of level sidewalks, memorable landmarks to support orientation and way finding, seating areas, and pedestrian-friendly access to public spaces and recreational areas enable outdoor mobility and continued engagement with the community. Separate avenues of research from home health care, gerontology, environment and behavior, social psychology, community health, preventive medicine and other diverse disciplines are starting to reveal the links between community, social, and physical environmental variables and health. A more focused examination that teases apart the impact of these variables and synthesizes the findings will aid in better understanding their contribution to improving home health.
External Environmental Factors

As portrayed in Figure 1, the external environment influences the safety and quality of home health care by shaping the context in which care is provided. Projections have the aging population with its plethora of acute and chronic care needs rapidly increasing in the decades ahead with the number of Americans 65 years and older expected to be 88 million by mid-century compared with 40 million in 2010. In a 2000 Home and Hospice Care Survey, 7.2 million individuals received formal home care services. Of these, 69 percent were older than 65 years, and approximately 64 percent were women. It is not that formal counts do not include a sizable proportion of nonformal, home health services provided by non-Medicare-certified agencies or lay caregivers.

Variation in home health and home care agencies in understanding and interpreting Medicare and Medicaid coverage guidelines is another external factor that influences the type and range of services provided. Despite the guidance that is available that aims to foster understanding about coverage, how the guidance plays out in rural communities, small towns, and cities across the nation is likely to vary as local agencies develop their own management practices (not always with safety and quality of care as foremost considerations) to ensure their financial viability in response to a challenging claims process (Silver MP, Ferry RJ, Edmonds C., unpublished data, 2009).

Strong disruptive economic forces and a rapid pace of change are the early hallmarks of a dynamic 21st century. Scientific and technological advances are changing the ways and places where health care gets delivered. Although uncertainty may be the best way to characterize government initiatives and care health care policy for the present, there is hope that a more proactive and unified political climate will prevail as we approach the end of the first decade. A major rethinking of current assumptions along with new visions and models of care—responsive to external forces, tailored to the unique conditions of the home setting, and sensitive to the vulnerabilities of home patients and their caregivers—will be needed.

CONCLUSIONS

A conceptual model has been introduced that focuses on the human factors vulnerabilities in the home health care setting, making it both a patient- and provider-centric model of care. It is a model of care that underscores the importance of system components and their interdependencies. If the components and their interactions are ignored, the prospects for safe and high-quality care are indeed bleak. A home health care system that expects good results from the convergence of elderly patients with multiple chronic conditions and providers with varying skill levels as they attempt to interact with sophisticated medical devices and new technologies in physical and social environments not well designed, supervised, or regulated for the receipt of health care services is cause for concern.

Safety has been described as a dynamic one-estate. It takes a lot of work and attention to the interdependencies for nothing bad to happen in challenging environments. While greater systems awareness is needed in many sectors of health care, aspects of outpatient care have started to improve with greater recognition of system interdependencies and human factors considerations. Notwithstanding the need to develop its own safety and quality knowledge base, home health care has an opportunity to benefit from these lessons learned.

REFERENCES


47. McCallough MC. Home modification: how to help patients make their homes safer and more accessible as their abilities change. Am J Nurs. 2006;106(10):54–63.


