Needs determination for a community approach to health-care delivery

Fay Cobb Payton
Management Information and Decision Systems, Weatherhead School of Management, Case Western Reserve University, Cleveland, OH 44106, USA

Patricia Flatley Brennan
Frances Payne Bolton School of Nursing, Case Western Reserve University, Cleveland, OH 44106, USA

Michael J. Ginzberg
Management Information and Decision Systems, Weatherhead School of Management, Case Western Reserve University, Cleveland, OH 44106, USA

Abstract: Computer technology has been effectively used by care-givers in the delivery of health-care services to persons living with AIDS and care-givers of those with Alzheimer's Disease. Recently, in an exploratory study, the concept of using computer technology to provide home-care support to a group of care-givers and paediatric patients at a specialty hospital in Northeast Ohio has been proposed. Unlike previous computer-based health-care delivery systems that have focused on one type of user, the proposed technology will assist three user groups: care-givers, children and hospital professionals. A second unique aspect is the integration of the technology into the hospital routine. Major decision-makers, who are also hospital professionals, have been identified and interviewed to determine their needs. A structured analysis using critical success factors / future state was used to review and determine the existing hospital processes. Findings indicate that the facility has a unique need for out-of-hospital patient management, and a community approach is needed for care delivery. Myriad post-discharge planning and external community activities must be supported by the proposed technology. Based on pre-implementation findings from the critical success factors / future state, specifications were developed for a decision-support system that includes a variety of tools designed to meet the needs of the diverse user base. Decision-support systems will aid in semi-structured decision-making and allow users to access data to make such decisions.

Keywords: decision-support systems; critical success factors; future state; community health information; implementation of networks.

Biographical notes: Fay Cobb Payton is a Management Information and Decision Systems doctoral candidate at the Weatherhead School of Management, Case Western Reserve University. Following several years of industry experience, Ms Cobb Payton received a Masters of Business Administration in Information Systems and Marketing from Clark Atlanta University, Atlanta, Georgia. As a Dual Degree Engineering Student, she received a Bachelor of Science in Industrial and Systems Engineering from the Georgia Institute of Technology and a Bachelors of Arts in Accounting from Clark College (now Clark Atlanta University). She has published in the Proceedings of the Decision Science Institute. Ms Cobb Payton's interests include health-care information systems, community and enterprise networks, and systems implementation.

Patricia Flaitley Brennan, PhD, RN, FAAN, is currently Associate Professor of Nursing and Systems Engineering at Case Western Reserve University, Cleveland, Ohio, USA. Dr Brennan received a Masters of Science in Nursing from the University of Pennsylvania and a PhD in Industrial Engineering at the University of Wisconsin-Madison. Following seven years of clinical practice in critical care nursing and psychiatric nursing, Dr Brennan has held several academic positions. She developed and directed ComputerLink, an electronic network designed to reduce isolation and improve self care among home-care patients. Dr Brennan currently serves on the Cuyahoga County Board of Mental Retardation and Developmental Disabilities. Dr Brennan is a Fellow of the American Academy of Nursing and the American College of Medical Informatics. She is Associate Editor of the Journal of the American Medical Informatics Association.

Michael J. Ginzberg, PhD, is Professor of Management Information and Decision Systems and Associate Dean for Professional and International Programs at the Weatherhead School of Management, Case Western Reserve University. He has previously served on the business or management faculties of the Massachusetts Institute of Technology, Columbia University, New York University, and Erasmus Universiteit, Rotterdam, The Netherlands. Dr Ginzberg's research, teaching and consulting interests focus on managing information services activities, development of decision-support systems, implementing new information systems and organizational arrangements, management of technical professionals, and the international deployment of information technology. Dr Ginzberg has published more than 35 articles and chapters and has co-authored or co-edited six books on these topics. He currently serves on the editorial boards of MIS Quarterly, the Journal of Management Information Systems, and the Revue des systèmes de décision.

1 Introduction

Computer technology has been effectively used by care-givers in the delivery of health-care services to persons living with AIDS and care-givers of those with Alzheimer's Disease. Recently, the concept of using computer technology to provide home-care support to a group of care-givers and paediatric patients at a specialty hospital in Northeast Ohio has been proposed. The proposed technology will support care-givers, paediatric patients and hospital professionals. Because of the broad user base, the proposed technology will link the hospital, care-givers, children, and other community entities. The findings of this exploratory study can serve as a model for future community
networks in an attempt to deliver health care and reach segments of society otherwise left unserved.

The computer network is expected to be integrated into the hospital's daily operations. Consequently, a structured analysis technique using critical success factors/future state was used in order to determine points of intervention. This analysis strategy helped determine the state of existing processes and the nature of process improvements that could result through using an electronic computer network (i.e., by implementing change). The structured analysis helped to determine system requirements. Critical success factors/future state involves defining the desired future state and examining those things that an organization must achieve if it is to successfully reach its desired future state.

This paper will examine the functionality needed to link hospital professionals, pediatric patients and care-givers. Requirements definition for the proposed technology and methods used to determine these requirements are discussed. Results of the analysis, as well as the definition of decision-support tools needed to meet these requirements, are presented. From the initial findings, the Post-Discharge Processes emerged as the likely point of intervention for the proposed technology. Throughout this paper, an integrated example of how the recommended technology can aid in the hospital's current Post-Discharge Processes will be used. Finally, a summary, some limitations, and issues for the next step in the design phase will be discussed.

2 Hospital background

This study was conducted in a large pediatric hospital located in Cleveland, Ohio, USA. The facility is a full-service rehabilitation, pediatric specialty hospital, Accredited in 1965 by the Joint Commission on the Accreditation of Health Care Organizations, the hospital has the unique charge to provide residential rehabilitation between acute hospitalization and home discharge. The hospital provides patient care education and training to care-givers during the patient's length of stay. Such training enables parents to be more self-sufficient and less reliant on hospital staff.

Major service offerings provided by the hospital include recreational, physical, occupational and speech therapies, language education, psychological and medical treatments, and nursing. These offerings permit the organization to care for a diverse group of children with a variety of illnesses including failure to thrive, diabetes, cerebral palsy, development delay and head injuries.

The current patient base consists of newborns, toddlers and teenagers. Patients are typically referred to the facility from other hospitals or agencies. Patients generally return home after six to eight months of care.

The hospital has a great deal of interest in managing those pediatric patients who have been discharged from the facility. Discharged patients generally obtain medical, educational and financial support from external agencies. Hospital decision-makers are in constant communication with these agencies to ensure that its patients are receiving adequate care and treatment. Adequate care and treatment reduce the likelihood that patients will be readmitted or continuously readmitted to the hospital. This out-of-hospital management issue means that the proposed technology must adequately meet the planning and community contact needs of the user base. As a result, the focal point for the technology introduction will be the Post-Discharge Processes.
3 Problem and purpose

Family care-givers face numerous challenges as they try to provide adequate care to patients in the home. Brennan et al. [1] found that these problems range from acquiring relevant information to combating social isolation and maintaining social support. The use of computer technology has assisted care-givers of those with Alzheimer’s Disease and persons living with AIDS by addressing and reducing these challenges [1,2].

Brennan et al. [1] addressed the issue of home care to AIDS/HIV and Alzheimer’s Disease patients by developing ComputerLink. The ComputerLink resides on a free, public access community network, the Cleveland FreeNet. The functionality of ComputerLink includes an electronic encyclopaedia, decision-support system, and communication pathway [1]. CHESS, another free-standing system, supports people with, and those at risk of contracting infection from, AIDS and HIV. Bosworth and Gustafson implemented this computer-based health-care delivery system to provide four capabilities: information, decision support, referral, and social support [2].

Both systems have similar functionalities. The information functionality stores, retrieves and displays AIDS/HIV and Alzheimer’s Disease literature. Users can select from a variety of treatment, diagnosis and coping information. Decision support enables users to evaluate and/or change alternatives and behaviours. Decision alternatives are based on the users’ personal values and norms. Additionally, the referral component details and lists those disease-related services available to patients and care-givers. Users are thus made aware of pertinent social, financial and medical services, and how to access them. Lastly, social support empowers users by providing private mail and on-line discussion groups. Users can communicate with either individuals and/or on-line support groups. These groups often share experiences and challenges associated with AIDS/HIV or Alzheimer’s Disease. More importantly, the technology enables users to avoid the social stigmas often associated with these diseases.

These existing systems do offer a strong foundation from which the proposed technology can be built. These computer networks, however, are narrow in scope, in that each supports a single type of health-related condition (i.e. AIDS/HIV and Alzheimer’s Disease). These systems do not reach the diverse constituents commonly found in health-care delivery systems. To meet the needs of all constituents and involve various entities, the proposed technology must be substantially broader and can best be described as a community model for health-care delivery.

This community model is based on continuous care delivery beyond the traditional, physical hospital facility. Care delivery broadens the hospital’s space to include a community of care providers, medical vendors, schools, and social service and financial entities. Thus, each community member is needed to deliver continuous care during the patient’s hospital stay and once the patient is discharged.

The community approach to health-care delivery is enabled by the proposed technology which will link multiple entities and users. Further, the technology empowers patients and care-givers by giving them access to health-care information, support groups and referral services.

An electronic computer network that will address some of the challenges faced by health-care professionals, care-givers and paediatric patients has been proposed to, and accepted by, key decision-makers at the hospital. One feature of the proposed technology is a decision-support capability that includes a variety of tools that will meet the needs of the user base. The decision-support capability, which will be similar to that provided in
both CHESS and ComputerLink, will allow care-givers to access information about resource availability, referral and medical information. By accessing this information, care-givers can make a variety of decisions that will aid in the administration of educational, financial and medical care to paediatric patients. For example, care-givers could select from a variety of illnesses and choose from a list of care delivery practices. Paediatric patients, on the other hand, will be able to communicate electronically with other patients with similar conditions.

Professionals include, but are not limited to, nursing, occupational, speech and recreational therapy, admissions, and physician staffs. The decision-support capability will assist health-care professionals who are faced with referring patients to proper services, supplying care-givers with reminders for medical, educational and social services appointments, and monitoring care-giver decision-making. For example, professionals could evaluate social services based on a patient's needs, location and demographic background. Once a service has been chosen, the professional could inform the care-giver of the appropriate service via an electronic message. These demands often place professionals in a situation of continuous case management [3].

The key challenge is to determine the requirements of health-care professionals to support care-givers and to overcome any technology adoption barriers. Key hospital decision-makers were solicited for their ideas about how the proposed technology 'fits' into the delivery of health care. To accomplish this, multiple methods were used to address decision-makers' views about technological, social and economic barriers to the proposed electronic link. Multiple views resulted from multiple constituents.

4 Methods used in the study: critical success factors / future state

Dowling [4] developed the critical success factors / future state (CSF/FS) method based on future state concept developed by Beckhard and Harris [5] and critical success factors developed by Rockart [6]. Rockart identified the sources of critical success factors as the industry structure, competitive strategy, industry position, environment, and geographic location [6].

Further, Dowling [4] holds that critical success factors / future state (CSF/FS) requires an organization to look beyond its current problems and conditions and determine what actions and results are required if the organization is to thrive in the future. Future state represents the set of conditions that an organization would like to obtain in the future, and critical success factors, once accomplished, are those items that will get an organization to its desired future state. Using the CSF/FS method for the interviewing process offered numerous advantages. It:

1. permitted an active role in the requirements definition by top management and key decision-makers;
2. created a pragmatic vision of the hospital operating with the proposed technology;
3. gained support from major influence leaders, top management, and decision-makers; and
4. established what the system must accomplish from each user group's perspective.

To determine the critical success factors / future state, semi-structured interviews were conducted by the first author over a six-week time period with nine major hospital
decision-makers. Each interview lasted 60 to 90 minutes. Decision-makers to be interviewed were identified primarily by the hospital’s President/Chief Executive Officer (CEO) who provided full support for the project. These decision-makers provided information on the existing system, users’ needs, the role of the proposed technology, and the impact of the technology on current tasks. Appendix 1 lists those health-care professionals interviewed, and Appendix 2 includes the instrument used during the data gathering process.

After each interview, notes were summarized immediately. Decision-makers were given the opportunity to suggest changes and/or additions to their transcripts. When inconsistencies between respondents emerged, the first author met with the appropriate decision-maker to resolve such issues. For example, after several interviews, the admissions processes were rather fuzzy. Second and third meetings were held with the Admissions Director to clarify the pre- and post-admissions processes as well as their associated activities. Current and future state process flow diagrams were agreed upon. These diagrams are presented and discussed in a later section.

Data were not gathered directly from the care-givers or patients. Health-care professionals provided detailed description of the problems faced by each of these potential users. Additional data, however, were gathered by the first author via direct observation of the patients. Children (i.e. patients) were observed playing mathematics, reading and speech educational games. The Directors of Occupational Therapy and Admissions provided the first author with further explanation and insight when needed.

For an assessment of the hospital’s future direction, the President/CEO suggested that the first author meet with the Medical Director. The Medical Director clarified the hospital’s intended future state and strategic direction. He had clear ideas about and goals for the hospital’s service offerings, health-care delivery system and future alliances. These were, however, the Medical Director’s vision. No formal planning documents existed which could convey the Director’s vision. It is worth noting, however, that the Medical Director had joined the hospital staff only two months prior to the study.

According to the Medical Director, the future state of the organization is to continue to provide high-quality and timely health care to its paediatric patients. This includes continuous improvement in the hospital’s current out-of-hospital patient management system. The hospital is currently investigating a three-fold plan and considers these factors as critical to success:

1. analyse new markets to provide services through alliances with other local and surrounding area hospitals;
2. provide new clinical services while improving existing services; and
3. recruit individuals to conduct research.

5 Findings from critical success factors / future state: user groups

The data collected were clustered to provide profiles for each potential user group. Although only the health-care professionals were interviewed, these professionals consistently referenced their individual needs as well as those of the care-givers and children.

The critical success factors analysis uncovered a range of requirements that the proposed technology must meet. Table 1 lists these requirements by user group. To gain a
Table 1  System requirements uncovered by CSP/FS

<table>
<thead>
<tr>
<th>Requirements</th>
<th>User group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of use</td>
<td>All</td>
</tr>
<tr>
<td>Menu-driven</td>
<td>All</td>
</tr>
<tr>
<td>Graphic/iconic interface</td>
<td>All</td>
</tr>
<tr>
<td>Ease of data entry and retrieval</td>
<td>All</td>
</tr>
<tr>
<td>Adequate funding</td>
<td>All</td>
</tr>
<tr>
<td>Resource availability information</td>
<td>All</td>
</tr>
<tr>
<td>System support staff</td>
<td>All</td>
</tr>
<tr>
<td>Public Law #94-142 information</td>
<td>Care-givers</td>
</tr>
<tr>
<td>Educational games</td>
<td>Patients</td>
</tr>
<tr>
<td>Addresses broad literacy rates</td>
<td>Care-givers and patients</td>
</tr>
<tr>
<td>Reduce social isolation</td>
<td>Care-givers and patients</td>
</tr>
<tr>
<td>Programmed instruction</td>
<td>Care-givers and patients</td>
</tr>
<tr>
<td>Quality management implementation</td>
<td>Health-care professionals</td>
</tr>
<tr>
<td>Minimize medical liability</td>
<td>Health-care professionals</td>
</tr>
<tr>
<td>Comparative study of system utilization</td>
<td>Health-care professionals</td>
</tr>
<tr>
<td>Consistent patient sample</td>
<td>Health-care professionals</td>
</tr>
</tbody>
</table>

*Note: ‘All’ indicates health-care professionals, care-givers and patients.*

A better understanding of why these requirements are so broad for these diverse groups, Table 2 shows a summary of responsibilities by user type.

Because of the diverse literacy rates among its paediatric patients and care-givers, hospital decision-makers have a high degree of concern that the technology be simple and easy to use. Therefore, the technology should be menu-driven, iconic, and provide ease of data entry and retrieval. School system education that will provide learning and educational modules for school-aged patients should be incorporated. This will permit children to continue their education while confined to the home. Similarly, the proposed link will provide information on Public Law #94-142. This law requires that schools provide the necessary facilities for handicapped children to attend regular school sessions. According to hospital professionals, care-givers are typically unaware that schools are required by legislation to do so.

Moreover, hospital professionals are interested in doing a post-implementation comparative study of how the technology is used. The study would show system utilization rates by patients and care-givers, time spent on the system, what tools are least and most widely used, would trace different patients with varied episodes of illnesses, and determine what resources are needed but missing from the hospital’s current product mix. Such a study would support the desired future state by providing the hospital with information needed to analyse new markets, explore new clinical services, and improve existing services.

To monitor quality of care over time, a consistent patient sample is needed to accurately determine the technology’s impact on the delivery of care. This sample also creates a basis for comparison in the comparative analysis study. Ideally, the sample
should include patients with whom the hospital will have a continuing interaction. This permits the technology to aid in tracking resource utilization, forecast resource needs based on stages in an episode of illness, and determine improvements in health as a result of the technology. Additionally, the technology can aid in the assessment of resources needed but not available by the hospital. These issues relate to the hospital's future state and three-fold plan for achieving it.

Presently, the hospital uses educational games to facilitate and simplify patient learning. The facility addresses the wide range of literacy rates by tailoring its educational offerings to care-givers and patients, implements quality management, and attempts to minimize the medical liability. Therefore, the decision-makers view the continuation of these existing items as critical success factors for the future state and the proposed technology.

The critical success factors / future state method also revealed other systems requirements for the proposed electronic link. The technology must aid in the reduction of care-giver and patient social isolation and provide medical, educational, financial and social resource availability information to its users. Unlike the existing system that uses telephone technology, these factors will be met through the use of an electronic computer link. The link will provide a vital service to ruraly located patients and care-givers, those patients who lack transportation, and those patients who are too ill to transport. For the hospital, the link will reduce the number of non-billable activities performed by professionals, improve out-of-hospital patient management, and reduce redundancies in the current system.

<table>
<thead>
<tr>
<th>Group</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>Complete grade/high school education</td>
</tr>
<tr>
<td></td>
<td>Provide care for patients in the home</td>
</tr>
<tr>
<td></td>
<td>Maintain work status</td>
</tr>
<tr>
<td></td>
<td>Research/contact appropriate medical, education, etc.</td>
</tr>
<tr>
<td></td>
<td>resources for patient care</td>
</tr>
<tr>
<td></td>
<td>Complete medical education assessment plans</td>
</tr>
<tr>
<td></td>
<td>Provide care to other family members and the patient</td>
</tr>
<tr>
<td>Care-givers</td>
<td>Transport patients to/from scheduled appointments</td>
</tr>
<tr>
<td></td>
<td>Notify health-care professionals and others of patient</td>
</tr>
<tr>
<td></td>
<td>problems and concerns</td>
</tr>
<tr>
<td></td>
<td>Schedule patients' medical/educational appointments</td>
</tr>
<tr>
<td>Health-care professionals</td>
<td>Conduct resource scheduling</td>
</tr>
<tr>
<td></td>
<td>Conduct patient/care-giver follow-ups</td>
</tr>
<tr>
<td></td>
<td>Provide resource availability information</td>
</tr>
<tr>
<td></td>
<td>Conduct inter-agency meetings</td>
</tr>
<tr>
<td></td>
<td>Provide/track medical education to/of care-givers</td>
</tr>
<tr>
<td></td>
<td>Identify post-discharge patients' needs</td>
</tr>
<tr>
<td></td>
<td>Provide answers to care-givers' questions and concerns</td>
</tr>
</tbody>
</table>
Decision-makers are concerned about adequate funding for the technology. Once patients and care-givers become reliant on the technology, funding for its continued operation may not be available. Thus, patients and care-givers will have little or no support from the current system or the proposed technology.

System staff support and programmed instruction will be needed. Systems training and education will be provided to all user groups while programmed instruction will be provided in modular form to care-givers and patients. Modularity will provide ease-of-use and assist system acceptance by the users. Programmed instruction could be self-paced by the user and provide educational support for different types of illnesses.

Decision-makers also provided a comprehensive list of user responsibilities (see Table 2) during the interviewing process. These responsibilities helped to determine the functionality needed by the proposed computer network and how users can benefit from use of the technology.

6 Other methods used, and findings

Several other methods were used in combination with the CSF/FS to assess the concerns of the decision-makers. These include extrapolation and mimicking. Each method helped to specify the requirements of the proposed technology, and each was used at different points in the structured analysis. Each method also suggested a variety of alternatives to the existing system that would aid in systems design. Through their participation in using these methods, decision-makers gained a clearer understanding of how portions of the current system could be used and portions of existing home-based technologies can be adopted.

Extrapolation involves analysing the existing hospital system and determining what functionality can be used to realize needed capabilities. The current home-care system is primarily manual and is heavily reliant on telephone technology. Computer technology will be introduced during the Post-Discharge Processes to enhance the existing system. The existing system, however, has been used to determine as well as understand the hospital’s Post-Discharge Processes and activities. The addition of another post-discharge sub-process will result. These processes will be discussed later in the paper.

Mimicking involves analysing the functionality of existing systems and determining what, if any, of the functionality could be used by the proposed electronic link. ComputerLink was assessed by the first author, who interviewed its principal researcher. The first author also gained hands-on experience with ComputerLink and reviewed its existing functionality. Based on careful readings of the literature, the CHESS capabilities are similar to those used by ComputerLink and those proposed for the hospital. CHESS and ComputerLink each support a single type of illness: HIV, AIDS or Alzheimer’s Disease. Mimicking, however, permits the use of similar functionalities such as those found in CHESS and ComputerLink. For the proposed technology, these include decision-support tools, on-line support groups, communication pathways, and referral services.

In addition to supporting care-givers and professionals, the proposed system will support paediatric patients who range in age from one day to 18 years, and who have varied literacy rates. Thus, the uniqueness of the proposed system is that it will allow support to a diverse user base, broad episode of illnesses, varied literacy rates among
patients and care-givers, and will provide out-of-hospital patient management tools that will link the external community to the hospital.

7 Existing system description

From the critical success factors / future state method, it appeared that the Post-Discharge Process would be an effective and efficient point of intervention. Through the following example, the Post-Discharge Processes are used to illustrate how the computer network could be used.

Currently, we can identify five processes as shown in Figure 1. During Process 1, 'Identify patient post-discharge needs', an inter-disciplinary team that consists of physician, nursing, occupational, recreational, speech, social work and admissions staff determines the medical, educational, social, etc. needs of the patient. Typically, this process occurs within 3–5 days of admission. Hospital services are closely matched to address the patient's needs, and the team determines who is responsible for administering the needed services. Once the patient is admitted, care-giver education is immediately started.

Figure 1 Existing post-discharge processes

Process 2, 'Conduct inter-agency meetings', normally occurs in 2 to 3 weeks before the patient is discharged. Inter-agencies are external entities that provide needed services to the patient. They may include local schools, medical equipment vendors, and speech, physical, recreational and occupational therapy providers. During these meetings, the hospital and the inter-agencies attempt to avoid redundancies in services. Further, these agencies are the sources that link the hospital to the external community and are vital to the facility's out-of-hospital patient management services.
patients and care-givers, and will provide out-of-hospital patient management tools that will link the external community to the hospital.

7 Existing system description

From the critical success factors / future state method, it appeared that the Post-Discharge Process would be an effective and efficient point of intervention. Through the following example, the Post-Discharge Processes are used to illustrate how the computer network could be used.

Currently, we can identify five processes as shown in Figure 1. During Process 1, 'Identify patient post-discharge needs', an inter-disciplinary team that consists of physician, nursing, occupational, recreational, speech, social work and admissions staff members determines the medical, educational, social, etc. needs of the patient. Typically, this process occurs within 3–5 days of admission. Hospital services are closely matched to address the patient's needs, and the team determines who is responsible for administering the needed services. Once the patient is admitted, care-giver education is immediately started.

Figure 1 Existing post-discharge processes

Process 2, 'Conduct inter-agency meetings', normally occurs in 2 to 3 weeks before the patient is discharged. Inter-agencies are external entities that provide needed services to the patient. They may include local schools, medical equipment vendors, and speech, physical, recreational and occupational therapy providers. During these meetings, the hospital and the inter-agencies attempt to avoid redundancies in services. Further, these agencies are the sources that link the hospital to the external community and are vital to the facility's out-of-hospital patient management services.
In Process 3, ‘Provide family education’, the nursing, dietary and recreational, physical, occupational and speech therapy staffs start conducting care-giver education. This begins on the day of admissions and becomes more formal as the patient’s length-of-stay (LOS) and medical condition are determined. The staffs coordinate their educational sessions based on the care-givers’ needs and medical knowledge.

Further, and based on the current system, Processes 2 and 3 tend to overlap. Here, the hospital immediately attempts to identify those community or inter-agency resources needed by the patient. This may require weeks of coordination among needed resources. As such, Process 2 is an on-going set of activities and is critical to the out-of-hospital patient management mission.

Therapeutic leave days (TLDs) are granted to the patient in Process 4. As indicated by hospital professionals, this is a critical process because it gives the care-giver, patient and family an opportunity to experience the day-to-day demands of patient home care. TLDs are usually overnight weekend visits from Saturday to Sunday. By this point in the process, the hospital staff has worked diligently to ensure that the proper medical equipment is in the home.

Finally, Process 5, ‘Discharge of patient from the hospital’, occurs. During this process, staff members work to ensure that adequate care-giver education and preparation has been administered. Needed services and resources are in place at this point, and periodic follow-ups are conducted by social work and admissions staff members.

8 Problems with the existing system

Although the hospital effectively manages the existing system, problems do exist. Major tracking of patient and care-giver education is primarily manual and paper-driven. Therefore, changes and additions to care-giver and patient education files cannot be done simultaneously by different hospital departments. Also, each department maintains a separate file for care-giver and patient education.

Out-of-hospital patient management is highly telephone-dependent. Care-givers phone the hospital’s case manager who answers questions on resource availability information, schedules appointments to external facilities, conducts post-discharge follow-up calls, and provides answers to other questions and concerns. The hospital presently has only one case manager who handles all of these issues for a sizeable patient population. As a result, the case manager may be overwhelmed by the number of care-giver requests.

Care-givers and patients do not have a social outlet if the patient is heavily confined to the home. For those children confined to the home, support groups and school attendance are non-existent. Care-giver support groups may require that the care-giver, who often must maintain a normal work schedule and care for his/her family, leave the home environment. This may be difficult to do in some cases.

Professionals have also indicated that care-givers are frequently uninformed or misinformed about the availability of resources within the community. These situations have resulted in missed opportunities for care-givers and patients to receive financial assistance, proper medical equipment and timely medical care.

Based on the existing system problems, the solution is the proposed technology that provides a ‘link’ among patients, care-givers, the hospital and the community.
The technology will focus on the hospital’s out-of-hospital management point of intervention, the Post-Discharge Processes. In addition, this solution follows the community model of health-care delivery and seeks to provide care within and outside the hospital environment.

9 Results: changes as a result of the proposed computer link

Given the problems with the existing systems and the findings noted above, a modified post-discharge process is suggested. This modified process would be supported by the proposed technology and would enable the hospital to improve its out-of-hospital patient management process. Unlike the health-care professionals, patients and care-givers are transients throughout the Post-Discharge Process. Consequently, there would be a continuous need to train and educate patients and care-givers on the proposed technology. This need is represented in Figure 2 as ‘Provide systems training’, and as a result of the proposed technology, it is the basis for moving from Figure 1 to 2.

As a result, the proposed electronic home-care system will build on the entire existing system by introducing the technology into a separate, new process. By using the existing Post-Discharge Process, the proposed modification will enable the hospital to improve existing procedures and minimize disruptions in care delivery. The addition of Process 2, ‘Provide home-care systems training to care-givers and patients’, will be introduced after Process 1, ‘Identify patient needs’. Such an addition offers benefits to the user base that the current system lacks. The resulting processes would then look as pictured in Figure 2.

Figure 2  Proposed changes to the current system
The electronic home-care system education is introduced during the early stages of the Post-Discharge Processes. Early introduction would allow a gradual adoption and acceptance by the user base. Likewise, it will enable step-wise education to avoid overwhelming users and assist with system acceptance by the users. This process is divided into the following sub-processes: ‘System introduction’ and ‘Modular education’.

System introductions will give patients and care-givers an opportunity to actually view the technology. Demonstrations can provide a theoretical framework for users and provide insight into system features that can support their needs. Modular education is suggested to avoid information overload by the user base.

Once completed, the hospital’s family centre will provide temporary living quarters for patients who have weekend discharge (known as Therapeutic Leave Days) and their care-givers. These quarters can be used to provide patients and care-givers with the proposed technology training, orientation and discharge preparation before the patient is officially discharged from the hospital.

As a result of the technology link, care-givers will be able to electronically obtain resources availability information. First, the technology will permit care-givers to use question and answer sessions from an electronic encyclopaedia regarding resources availability, medical conditions and clinical care information. Resources included are financial, medical equipment, speech, occupational and physical therapists, and education providers that may assist care-givers and patients. These resources provide the hospital with the necessary link to offer quality out-of-hospital patient management services. Second, the technology will provide care-givers with a decision-support function which will provide alternatives to patient care and problems. Lastly, a communication link will provide both patients and care-givers with confidential electronic mail to communicate with other patients, care-givers and professionals. The link will also provide public information sections that mimic a bulletin board. These features can assist the care-giver to become more self-sufficient by becoming less reliant on the case manager and public agencies. Care-giver self-sufficiency and empowerment will also help to reduce the use of telephone technology and non-billable hours for the hospital.

The proposed technology will encourage and promote the information flows between the hospital and community. These information flows are most critical in Process 3 (Conduct interagency meetings), Process 5 (Grant leave days) and Process 6 (Discharge patient) as shown in Figure 2. The common thread shared among these processes is the patient’s preparation and transition from the hospital to the home environment. These processes require coordination among the hospital, medical equipment vendors, local schools and social service agencies. As such, specific types of information will flow through the proposed system and serve as the ‘link’ between the hospital and the community. This information includes patient profile information, medical equipment and requirements, needs and services match as recommended by the interdisciplinary team; and patient medical, financial and educational requirements.

Given the complexity of these information flows, redundant services should be avoided by both the hospital and community. To identify redundant services, system, hospital and community validations are recommended. Validations should spot service duplications. This is critical to avoiding higher and unnecessary health-care costs to the patient and health-care community as well as inefficient service utilization.
10 Decision support framework: DSS tools and users

Given the variety of users’ needs, critical success factors / future state, and alternatives faced by users, a novel component of the proposed electronic home-care technology will be decision support.

The proposed technology fits as a decision-support system (DSS) by providing decision-making tools to the diverse user base. For care-givers, appointment scheduling, resource selection (i.e. medical, educational, therapies, etc.), and care administration decisions will be supported. Care-givers will also have access to an electronic bulletin board for question and answer sessions, electronic mail to communicate with care-giver support groups, and medical, dietary, etc. educational modules that will provide training procedures for patient care. Ariav and Ginzberg [7] identified the provision of data access as a key DSS service. Additionally, the dialogue that governs the users’ interactions with the system is critical to identifying DSS functionality [7].

For professionals, resource availability, scheduling and forecasting decisions will be supported. The technology will aid in training and education assessment decisions for hospital professionals. Making multiple models available and providing a mechanism for managing and changing them is another key aspect of DSS support [7]. Provisions should be made for the models used by hospital professionals to be modified as their tasks change.

Patients do not make any decisions that the proposed technology will support directly with models. However, as the proposal stands, electronic mail for pen-pal services and educational modules will be available to patients.

Various DSS tools can be matched directly to the critical success factors of each user group. Such matching focuses the technology design and determines which services the technology should provide to its users. Table 3 shows the services provided by the decision-support capabilities and the content of the support provided to its users.

11 Discussion

The proposed technology’s uniqueness lies within two frameworks: integrated health-care networks and technology integration into care delivery. This study suggests that health-care organizations must expand their traditional views of care delivery and processes. Information technology can enable such expansion by integrating its use into health-care processes as well integrating diverse entities to implement these processes. To do so, a community model of health-care delivery is recommended.

Moreover, two issues of importance have resulted from this study. First, use of the critical success factors / future state method helped to focus management on its long-range objectives. This focus, then, enabled management to visualize the role of the proposed technology in the hospital’s future state. Thus, attention moved from simply linking care-givers and hospital professionals to linking care-givers, children, the hospital and other community agencies. This moved the hospital from operating in isolation to a community network model. These findings suggest that community networks can play a vital role in the future of health-care delivery [8].

Systems, such as the proposed technology, offer a foundation from which future health-care delivery organizations and providers can build. Naturally, future systems may need tailoring to meet the various needs of the users. Users, as pointed out by this study,
### Table 3  Service/content offerings

<table>
<thead>
<tr>
<th>Service</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referral information</td>
<td>Provides agency information directly to care-giver, including service availability</td>
</tr>
<tr>
<td>Electronic bulletin board</td>
<td>Provides factual information on medical conditions and question/answer sessions</td>
</tr>
<tr>
<td>Educational games lessons</td>
<td>Maintains current school education lessons for patients unable to attend regular classes</td>
</tr>
<tr>
<td>Skills training education</td>
<td>Assists the health-care professionals with assessing care-giver education; provides on-line educational tracking</td>
</tr>
<tr>
<td>Electronic mail with pen-pats</td>
<td>Reduces social isolation; can offer electronic support groups</td>
</tr>
<tr>
<td>Messaging for reminders</td>
<td>Reduces the need for professionals to continuously manage patients and provide reminders to care-givers</td>
</tr>
<tr>
<td>Appointment scheduling</td>
<td>Aids in decision-making and daily planning for the care-giver</td>
</tr>
<tr>
<td>Resource scheduling utilization</td>
<td>Allows professionals to determine resource utilization; assesses current serve offerings; aids in planning and sensitivity analysis</td>
</tr>
<tr>
<td>Resource forecasting</td>
<td>Helps predict what resources are needed with certain episodes of illnesses; improves resource scheduling.</td>
</tr>
</tbody>
</table>

will no longer be limited to hospital professionals. As a result of health-care reform and changes in the health-care delivery system, future community network users may include industry, academic, government and research groups. Integration of once isolated constituents will be an important critical success factor in the strategic use of health-care information systems [9].

Second, the proposed electronic home-care system offers important advances in the delivery of health care. It offers an alternative to the traditional face-to-face patient-physician contact. Unlike prior computer-based electronic systems, it will support a diverse user base, a variety of illnesses and literacy rates, and varied age population. It offers alternative delivery of care to paediatric patients who are located in rural environments, lack transportation, or may be too ill to transport. For care-givers and patients, information can be accessed when needed without restriction to office hours or work schedules [8].

Although the proposed system suggests alternatives in the use of technology and decision-support systems in health care, there are limitations that must be addressed. Hospitals, like all organizations, are ever-changing environments. Since the project is currently in a pre-implementation phase, organizational change may require a reassessment of the initial findings. A diverse user base has presented system specifications that have yet to be addressed by other health-care computer-based alternative delivery systems. The pre-implementation findings have revealed a large scope of users’ needs.
The proposed technology will assist the hospital to reach its future state by providing significantly improved outreach, follow-up and post-discharge care to patients. It will also electronically link the hospital with external community agencies to improve its out-of-hospital patient management services. In terms of the three-fold plan, it can provide information on what patients are being served, those that are not being served, which services are used, and the frequencies of use of the services. These findings can, then, assist the organization with analysing its current offerings (i.e., find additional improvements), determining what services are needed but not currently being offered (i.e., identify new markets), and tailoring its current research to analyse new markets and current offerings (i.e., conduct research).

A major concern of the decision-makers is medical liability and the dissemination of accurate information to care-givers. Care-givers will make decisions and administer care to patients based on the information provided by the technology.

The diverse user base, broad literacy rates, multiple episodes of illnesses and out-of-hospital patient management issues represent the unique characteristics of the proposed electronic home-care system as a means of alternative delivery of health care. These unique characteristics will impact design, implementation and operation of the proposed system.

As indicated earlier, the results highlighted in this paper are based on pre-implementation findings. To move the project forward, a formal cost–benefit analysis, feasibility testing and project planning should take place. First, the cost–benefit analysis should determine what resources are needed and the associated costs to implement the proposed technology. Expected benefits from the technology should be outlined. These benefits will then be compared to, and should outweigh, the costs associated with the technology.

Second, feasibility testing should be performed by an established project team. This should involve an examination of the technical, operational, economic, scheduling and human factors issues that affect implementation. Lastly, project management issues must be resolved. Project management should be a continuous process of coordinating all the necessary tasks to successfully implement the proposed electronic home-care technology. Therefore, a formal project team along with project managers or leaders should be established. Along with this determination, responsibility planning should follow.

Finally, system implementation issues must be identified beyond those mentioned above. Ginzberg identified three issues essential to the success or failure of any implementation. These are: (1) commitment to the project, (2) commitment to change, and (3) extent of project definition and planning [10]. Each will require the support and involvement of hospital decision-makers and users. Their support will make for a smoother transition from the current to future state (i.e., the proposed system).

Acknowledgements

The first author would like to thank Alan F. Dowling PhD and J.B. Silvers PhD for their comments on earlier drafts of this manuscript. An abbreviated version of this manuscript appeared in the 1994 Midwest – Decision Science Institute Proceedings.
References


