Simulated RN | Virtual Healthcare Agent

M2 | William Morse

Users

Stakeholders

The stakeholders of the Simulated RN population consist of two groups: the hospital (e.g., executive groups, board of directors, passive leadership, managers, employees and healthcare providers) and the patients. All of the shareholders have a vested interest in a positive outcome related to the project. Members of the hospital group want their patients to enhance their understanding of treatment and healthcare options, because they want better outcomes and to increase patient satisfaction (Bickmore & Jack, 2010; Boudreaux, Ary, Mandry & McCabe, 2000). The patient group wants to be informed about their healthcare in a manner that supports their level of comprehension and learning style, so that they can be empowered to make informed decisions, which can lead to better health outcomes and satisfaction (U.S. Department of Health and Human Services, 2000; Clark, Drain, Gesell, Mylod, Kaldenberg & Hamilton, 2005).

Target Audience

In the exploratory study, the target audience will focus on shareholders specific to the maternity post-partum unit of the hospital, during the post-delivery or recovery phase of hospitalization.

Primary Users: The primary user of the Simulated RN will be mothers of newborn infants and family members.

Secondary Users: The secondary users of the system will be typical hospital staff members common to a typical post-partum unit. Users will consist of maternity experts: obstetricians,

neonatologist, lactation consultants, certified nurse midwives, members of skilled nursing teams, and perhaps anesthesiologist.

The post-partum unit of the hospital was specifically targeted for this project for a key characteristic that may influence performance and design acceptance. It is anticipated that users from a technology driven generation will inevitably have more experience with virtual interactive interfaces, and therefore, will more likely accept such an interface as natural. As a result, women of childbearing ages provide a specific age range that increases the likelihood of previous contact with conventional technology.

Primary User Background Information

According to research by Livingston, Wang & Dockterman (2010), *The New Demography of American Motherhood* reported user related characteristics:

> Age: Mothers of newborns are older now than their counterparts were two decades ago. In 1990, teens had a higher share of all births (13%) than did women ages 35 and older (9%). In 2008, the reverse was true — 10% of births were to teens, compared with 14% to women ages 35 and older. Each race and ethnic group had a higher share of mothers of newborns in 2008 that are ages 35 and older, and a lower share that are teens, than in 1990.
>
> Marital Status: A record four-in-ten births (41%) were to unmarried women in 2008, including most births to women in their early 20s. In 1990, 28% of births were to unmarried women. The unmarried-mother share of births has increased most sharply for whites and Hispanics, although the highest share is for black women.
>
> Race and Ethnicity: White women made up 53% of mothers of newborns in 2008, down from 65% in 1990. The share of births to Hispanic women has grown dramatically, to one-in-four.
>
> Education: Most mothers of newborns (54%) had at least some college education in 2006, an increase from 41% in 1990. Among mothers of newborns who were ages 35 and older, 71% had at least some college education.
>
> Explaining the Trends: Trends cited above reflect a complex mix of demographic and behavioral factors that relate to various outcomes. For example, the higher share of college-educated mothers stems both from their rising birth rates and from women's increasing educational attainment. The rise in births to unmarried women reflects both their rising birth rates and the shrinking share of adults who are married.

> Attitudes about Parenthood: When asked why they decided to have their first (or only) child, the overwhelming majority of parents (87%) answer, "The joy of having children." But nearly half (47%) also say, "There wasn't a reason; it just happened."
>
> (Livingston, Wang & Dockterman, 2010, p.1).

Availability of Participants

Communication with the user groups consisted of informal discussions and ethnographic research. Observations and note taking were used to gather descriptive data in the target environment related to common user task scenarios. A patient user perspective was provided through unstructured interviews with acquaintances that recently had children within the past year. User input was provided predominately by subject matter experts comprised of the secondary user group. Participation by all user groups was voluntary.

Tasks

Tasks Analysis Overview

The observational data associated with user task activity was organized using a hierarchical task analysis. This method provided a better understanding of the application domain. A flowchart was constructed to illustrate the structural framework involved in the discharge process (see Appendix A). The top-level section included *generalized hospital procedures and tasks* related to hospital wide discharge summaries. A sublevel section was expanded to identify *the post-partum specific unit tasks* that integrated with the top-level section linked with teaching and discharge instructions. This section was further broken down into another sublevel section of specific *discharge teaching and instruction procedural topics.* A literature review provided supporting evidence to validate the essential framework.

Generalized Hospital Procedures and Tasks

In a hospital, a discharge summary is a medical document used when a patient's care transitions from one area of care to another, or to the home. The documentation of this process exists as part of the patient's medical record. The purpose of this documentation is to provide communication between health care providers—generally, between physicians and nurses—related to a patient's treatment and care.

The Joint Commission is an agency that provides evaluation, accreditation and certification for healthcare facilities in the United States. Joint Commission accreditation provides external validation of patient safety, clinical quality processes and standards for healthcare services. According to the standards set by the Joint Commission (Standard IM.6.10, EP 7), they mandate that six components must be present in all United States hospital discharge summaries. These components include (Joint Commission, 2012):

1. Reason for hospitalization.
2. Significant findings.
3. Procedures and treatment provided.
4. Patient's discharge condition.
5. Patient and family instructions (as appropriate).
6. Attending physician's signature.

The noteworthy component of the mandates associated with this initial prototype project relates to item five, the *patient and family instructions*. The patient and family instructions, often referred to as the discharge instructions, are a key component of the communication process between healthcare providers and patients. The distinction here is important to emphasize, because this communication is oriented with the patient and their ability to understand the instructions.

Post-Partum Unit Specific Tasks

The exploratory study will focus primarily on the post-partum unit of the hospital and mothers of healthy newborns. In a hospital, the physician will decide when it is safe for the mother and infant to be

discharged from the hospital. Procedures and other tasks that need to be completed before they can be discharged include, discharge teaching and instructions, completing appropriate paperwork, scheduling of follow-up appointments, any vaccines or procedures for the infant (e.g., circumcision), child seat safety confirmation, newborn screening tests, birth certificate and Social Security registration, and the final physical exam by the physician.

Discharge Teaching and Instruction Procedural Topics

The framework for patient education content will be adopted utilizing recommendations provided by the American Academy of Family Physicians (AAFP), with specific attention given to the *Discharge Procedures for Healthy Newborns* (Langan, 2006). According to Robert Langan (2006), parents should receive training to give them the ability and confidence to care for their newborn in these key areas: properly feeding the infant, urination patterns, bowel movements, umbilical cord care, skin care, genital care, signs of illness, prevention of sudden infant death syndrome, car seat selection and proper use, and follow-up appointments made at discharge (p. 850).

Physical Environment

Maternity centers and labor and delivery units of hospitals have been designed to enhance the special needs of pregnant women during labor, delivery and recovery. The Simulated RN will be designed to support the post-delivery phase of hospitalization or recovery phase. Generally, after delivery, the mother and infant are moved to a private room in the post-partum unit. The environment often includes sleeping accommodations, a family area, bathroom and shower, desk, television, and a telephone. The Simulated RN interface can be mounted to a wall or a mobile cart with an articulate arm, so that it can be unobtrusive to the environment when not in use. The articulate arm allows the interface to be positioned to support a patient sitting or lying down in a conventional hospital bed.

Motivational Factors

In the post-partum unit, the discharge teaching and education component is mandated for Joint Commission accredited hospitals and is required prior to discharge from the hospital (Joint Commission, 2012). As a result, all patients are required to complete this task in the discharge process in one form or another.

There are several reasons why patients might be motivated to use the Simulated RN interface. Foremost, lack of preparedness experienced by first-time mothers drives them into information seeking states by their lack of experience (George, 2005). This motivation is intrinsic, perhaps maternally driven by social instincts related to parental care of offspring and exists with the individual rather than as an external reward. Mervyn, et al (1996) has pointed to motivation factors in mothers related to an incentive salience and a need to know, arising from: education being valued, an eagerness to learn, preparation, learn about post-natal care and prevention of future problems. In accordance with education research, students who are intrinsically motivated are more likely to engage in tasks voluntarily to improve their skills, which may increase their mastery of a topic and enhanced cognitive processing (Wigfield, Guthrie, Tonks, & Perencevich (2004). Furthermore, research has shown that without structured medical advice, friends and family become the primary source of information which results in conflicting or fragmented knowledge (George, 2005). These results correlate with increased rates of adverse events and psychological morbidity after childbirth (Ho, et al, 2009; Weiss, 2003; Forster, Murff, Peterson, Gandhi & Bates, 2003).

Patient satisfaction is an inherit goal of both the primary user and secondary user groups. Research has shown that discharge education including post-partum depression information given to patients during the discharge process benefits psychological well-being (Ho, et al, 2009). In addition, the interface is designed to induce positive sensory stimuli motivating user feedback (e.g., the drive is a signal for response behavior to occur).

Analysis

Communication and Comprehension Domain

Communication is essential for the effective delivery of healthcare (Paasche-Orlow, M. K., Parker, et al, 2005; Kripalani S, LeFevre F, Phillips, 2007; U.S. Department of Health and Human Services, 2000). Many medical studies demonstrated a correlation linking deficiencies related to communication and information transfer to implications related to patient safety and the continuity of care (Kripalani S, LeFevre F, Phillips, 2007). In fact, evidence shows patients often misinterpret or do not understand medical information given to them by clinicians (Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, 1999).

The data indicate that a large portion of the United States population lacks sufficient general literacy to effectively perform medical treatments (e.g., proper wound care, follow medication plan) it needs. According to the National Assessment of Adult Literacy, only 12 percent of adults have proficient health literacy to carryout proper self-care (Kirsch, Jungeblut & Jenkins 1993; U.S. Department of Health and Human Services, 2000). Studies have shown that 19 percent of discharged patients from hospitals have an incidence of an adverse event within 30 days following hospitalization and one third were preventable (Forster, Murff, Peterson, Gandhi & Bates, 2003). Many researchers have reported the most common factor influencing the frequency of adverse events relate to poor communication between hospital caregivers and the patient during the delivery of discharge instructions (Forster, Murff, Peterson, Gandhi & Bates, 2003). The economic consequences of inadequate health literacy are substantial, estimated to cost the United States $73 billion per year (U.S. Department of Health and Human Services, 2000). In 1994, adults with low health literacy averaged 6 percent more hospital visits, and stayed in the hospital almost 2 days longer than adults with higher health literacy skills (U.S. Department of Health and Human Services, 2000).

Patient Satisfaction Domain

In addition, research has demonstrated that the patient perception of discharge instructions are a powerful predictor of overall satisfaction (Boudreaux, Ary, Mandry & McCabe, 2000). Patients often find that the quality of discharge instructions do not match the quality of other services within the hospital (Clark, Drain, Gesell, Mylod, Kaldenberg & Hamilton, 2005).

Communication and Malpractice Lawsuits

Clinician-patient communication problems involved in malpractice lawsuits include explanation of diagnoses is inadequate, the explanation of treatment is inadequate, the patient feels ignored, clinician fails to understand perspective of patient or the relatives, clinician discounts or devalues views of patients or relatives, and the patient feels rushed (Weiss, 2003, p.24).

Summary of Breakdowns

A significant body of research literature substantiates that the most common breakdown that occurs in the discharge process relates to communication between the healthcare providers and the patient. Communication is a central element and the underlying factor related to other secondary breakdowns: patient comprehension and satisfaction. Therefore, it is predicted that improvement in the communication domain during the discharge instruction process will simultaneously improve patient comprehension and satisfaction. Therefore, the Simulated RN will strive to improve the discharge method by providing an interactive learning environment that enriches user tasks through enhanced communication.

Gap Analysis: Time-Constraints and the Consistency of Patient Experiences

Discharge instructions in the post-partum unit of hospitals primary comprise face-to-face discharge teaching, paper based-instructions (e.g., discharge packet, photocopies, brochures) and watching video instructions (usually delivered through a television). Face-to-face consultation remains one of the best natural means of communicating. However, hospital units can be a busy place and the availability of medical staff can be limited, therefore the quality of the experience can vary from patient-to-patient. The Simulated RN can accommodate this task by increasing the availability (accessibility) of time spent with patients while providing a prescribed way of discussing and presenting learning material to achieve consistent user experiences.

Gap Analysis: Evaluation of Comprehension

Research has demonstrated breakdowns can occur when dealing with patients with low health literacy skills. Healthcare providers cannot look at a patient to see whether they have a limited understanding of their discharge information. According to Schillinger, Piette, et al (2003), physicians rarely perform an adequate evaluation of patients' comprehension of their care. Research has shown that patients often feel uncomfortable asking medical questions and avoid asking questions for fear of appearing "stupid" or annoying the clinician (Weiss, 2003). The Simulated RN can accommodate this task by evaluating the patients' understanding through techniques requiring the patient to confirm their understanding of information.

Gap Analysis: Adaptive Teaching and Instructional Framework

Hospital care providers attempt to support user diversity in teaching and use of instructional material, but the flexibility of the material and healthcare provider skill set have limited range. Access to additional assistance (e.g., language interpreter, visual image) is not always available. As much as 80% of minority and indigent patients in urban areas have insufficient levels of health literacy skills (Williams, Parker & et al, 1995). The Simulated RN can accommodate these concerns by providing content delivery

in multiple languages expanding the literacy range, including the use of nonmedical language by adjusting reading level. The system's ability to support multiple languages increases availability, convenience and approachability for users.

Furthermore, research literature indicates that using multimedia, including audio conversation, text, images and video increases patient understanding and recall (Morris, Halperin, 1979; Johnson, Sandford, Tyndall, 2003; Austin, Matlock, Dunn, Kesler, Brown, 1995). The system can accommodate the use of multimedia to ease understanding and user-friendliness.

Constraints

There are common constraints related to the system requirements and design implementation such as expense and access to technology; however, these are relatively minor to the objectives of the prototype design. Furthermore, factors such as screen size, font size are potential unintended constraints, which will have to be evaluated. The more challenging constraints of the system design are associated with the complex interactions, differences in patient abilities (e.g., touch interaction, hearing impairment, native language), as well as issues with the workflow.

The Simulated RN interface is not a basic website where users click a button and a new page loads. Instead, several media components are simultaneously synchronized to form a relationship between media characteristics and the user's engagement in the process. The process flow (e.g., prioritization of actions, assignments), animation, dialogue, computer generated speech has to be synchronized with the 3D animated virtual agent's lips and body gestures. The process had to support subtitles, including multiple languages while responding (e.g., delivering specific feedback) to user inputs. To address the influence of these elements in the design space, a constraint on workflow was established to maintain organization.

The flow of interaction related to the relevance of the material and what the patient desires were restricted in the prototype to focus exploration on the design space's usability measurement criteria (e.g., time required to learn, speed of user performance). The constraints were used to influence the design

implementation, so that users remained on task. In addition, the instructional design is modeled after genuine experiences, traditional pedagogy, where the instructor inherently drives instruction, not the student.

Lastly, there are sociocultural constraints such as parental perceptions, cultural constructs, and effect of competing maternal time demands that can influence design (Pelto, Levitt & Thairu, 2003). Parental perceptions and cultural constructs are preconceived notions that influence behavior. For example, breastfeeding is natural, it can enhance the health of babies and mothers. Despite the evidence breastfeeding rates are underwhelming (Murphy, 2003). In the past, women were encouraged to formula feed, and causing a lack of confidence in their ability to nourish their babies and this cultural construct persists today (Scott & Mostyn, 2003; Dykes, 2006). Constructivism considers knowledge to be constructed from experiences in which people engage, such as meaningful tasks, or authentic context important to the art and science of teaching (Vygotsky, 1978). To be effective in the design, and valued by the user, the process must be easy to learn and accommodate the user's ability to acquire knowledge in a satisfying manner.

User Tasks Summary

- Allow users to navigate the interface when they are prepared, or to locate desired information.
- Offer various instructional opportunities for the user to explore.
- Accommodate the users learning styles by providing them learning options.

Measures

The initial usability study will seek to gather information, explore and assess the functionality of the Simulated RN prototype for its usefulness. The tasks for this usability study will be scenario based and designed to answer the basic question of what are the main stumbling blocks for the user. General research questions include: How easily do users understand what is clickable, or how to interact; Can

users use the prototype without human assistance or training; How quickly can users perform common tasks?

The measurement criteria will be based on Nielsen's *Usability Engineering* (1993) measureable goals: time to learn how to operate the system, speed of user performance, and the rate of errors made by users and the user's satisfaction with the system. The prototype will not measure the user's retention of information presented in this study.

Usability Metrics

The usability metrics will provide information related to user actions regarding efficiency and satisfaction with the interface.

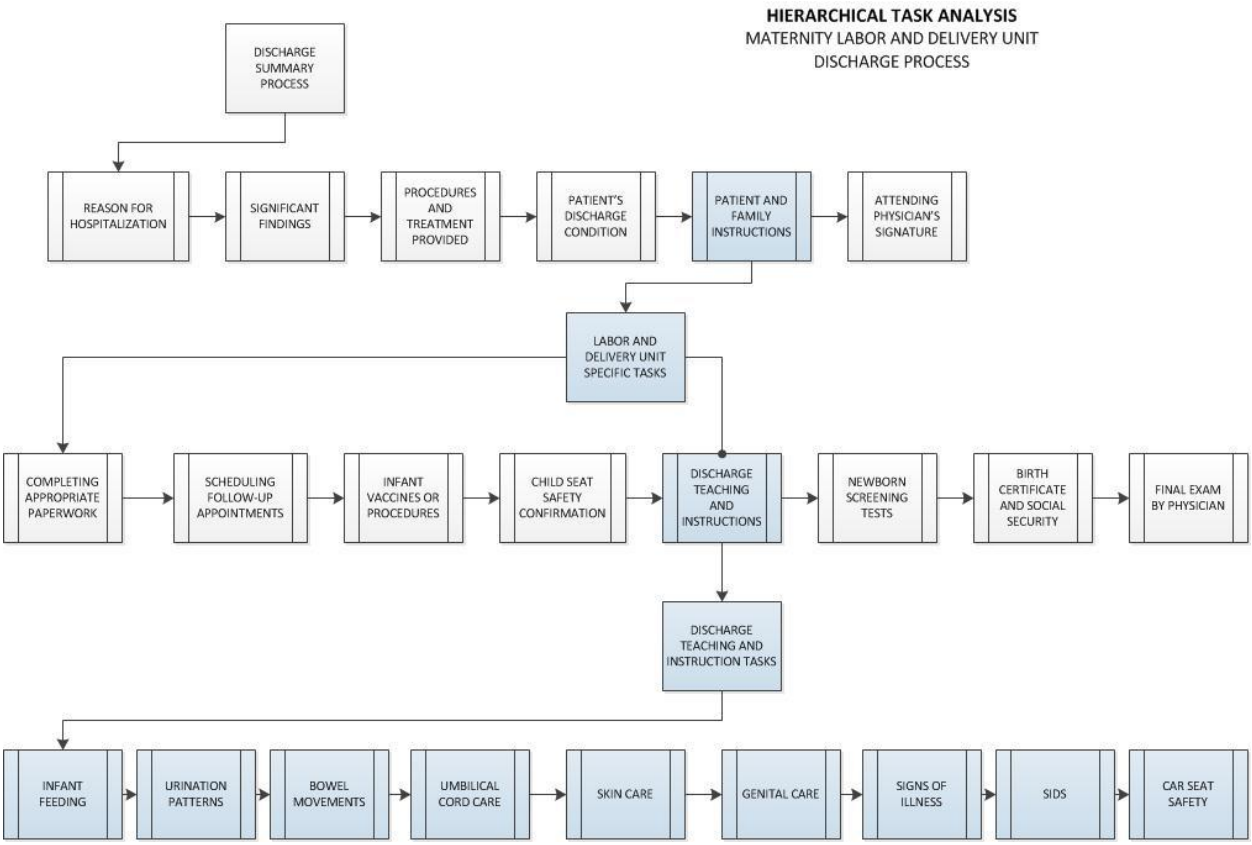
Quantitative measures to each of these research questions will be derived through these data source:

1. Count frequency related to failure to make a selection.
2. Count frequency related to the accuracy of a selection (e.g., correct or incorrect intention of selection).
3. Time required selecting (in seconds).

Qualitative measures will focus on attitudes toward the interface and satisfaction with the design. These measures will be self-reported items used to rate overall satisfaction with the interface, usefulness of the interface, comfort with the interface and acceptability of the interface.

The basic goal of the data collection will be to improve the system quality by finding prototype flaws. Data analysis will be descriptive related to performance data, such as task accuracy (e.g., percentage) and task timings (e.g. how much time do participants require to complete each task) and self-reported user feedback.

Appendix A


HIERARCHICAL TASK ANALYSIS
MATERNITY LABOR AND DELIVERY UNIT
DISCHARGE PROCESS
DISCHARGE SUMMARY PROCESS
REASON FOR HOSPITALIZATION
SIGNIFICANT FINDINGS
PROCEDURES AND TREATMENT PROVIDED
PATIENT'S DISCHARGE CONDITION
PATIENT AND FAMILY INSTRUCTIONS
ATTENDING PHYSICIAN'S SIGNATURE
LABOR AND DELIVERY UNIT SPECIFIC TASKS
COMPLETING APPROPRIATE PAPERWORK
SCHEDULING FOLLOW-UP APPOINTMENTS
INFANT VACCINES OR PROCEDURES
CHILD SEAT SAFETY CONFIRMATION
DISCHARGE TEACHING AND INSTRUCTIONS
NEWBORN SCREENING TESTS
BIRTH CERTIFICATE AND SOCIAL SECURITY
FINAL EXAM BY PHYSICIAN
DISCHARGE TEACHING AND INSTRUCTION TASKS
INFANT FEEDING
URINATION PATTERNS
BOWEL MOVEMENTS
UMBILICAL CORD CARE
SKIN CARE
GENITAL CARE
SIGNS OF ILLNESS
SIDS
CAR SEAT SAFETY

Patient Post-Delivery Recovery Room

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