The Digital Human Body of Knowledge

- Health Variant -

Strategy
Co-Design
Corpus
Operating Model

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MASTER DOCUMENT OF STATS AND REFERENCES – INCLUDING FINANCIAL

DEATHS - GLOBAL

- Classified as a Pandemic by WHO
- *Globally: 17.9 M* deaths per annum – 31% of all deaths (*Reference*: WHO 2019)
- *Globally:* number of people with CVD *353,121,000* (*Reference*: Global Atlas of CVD. World Heart Federation 2018)
- *Globally*: By *2030* – number of *deaths* due to CVD *23.6 million per year.*
- *Globally: >75%* CVD *deaths* occur in *low-income* and *middle-income* countries. (*Reference*: WHO 2019)
- *Globally:* Number of *CABG surgeries each year*: *800,000*. (*Reference*: Coronary Artery Bypass Graft (CABG) Market Analysis and Forecasts 2018-2025. Grand View Research.)
- US: Cardiovascular disease (CVD) remains the leading cause of death in the United States, responsible for *840,768* deaths (2016)
- Australia: *43,500 deaths* (2017) *30% of all deaths* (*Reference*: Australian Heart Foundation 2018)

US STATS

- Each year, *785,000* Americans will suffer a new myocardial infarction (MI; heart attack) and nearly *470,000* will have a recurrent attack. *Total: 1,255,000* per year. (*Reference*: American Heart Association Presidential Advisory 2011)
- *North America*: *56.9%* CVD share in *global CABG market*. (*Reference*: Coronary Artery Bypass Graft (CABG) Market Analysis and Forecasts 2018-2025. Grand View Research.)
- *US*: other figures: number of CABG procedures *200,000* per year. (*Reference*: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5906252/)
- *US*: Over *1.8 million stents* implanted *per year*. (Reference: iData Research. https://idataresearch.com/over-1-8-million-stents-implanted-per-year-in-the-u-s/)
- *US*: Number of *providers* = *7,200*. Number of *hospitals* doing cardiac procedures ~*1,700*. (*Reference*: Trends in U.S. Cardiovascular Care2016 Report From 4 ACC National Cardiovascular Data Registries)
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- *70 million Americans* suffer from CVD – and *90 million Americans with health illiteracy* - overlap. (*Reference*: *International Society for Vascular Health*, "Vascular Health and Risk Management 2006)
- *Women*: (Reference: American Heart Association website 2019)
    - No.1 cause of *death* in American women, claiming over *400,000* lives each year.
    - *Women of color* are disproportionately affected by heart disease; the *death rate was 25% higher* for black women than for white women in 2015.
    - Women are *1.5 times less likely* than men to be referred to *cardiac rehabilitation*.

AUSTRALIA

- CVD affects *4.2 million Australians.* (*Reference*: Australian Heart Foundation website 2019)
- CVD *hospitalisations*: *576,000* (*Reference*: Australian Heart Foundation website 2019)
- *Heart attack*: each year *57,000 Australians*. (*Reference*: Australian Heart Foundation website 2019)
- *Women*: (*Reference*: Women and Heart Disease: Cardiovascular profile of women in Australia. AIHW June 2010.)
    - *2 million Australian* women have CVD.
    - *200,000 hospitalisations* (2006-2007)
    - *Less likely* when hospitalised to receive: diagnostic treatments; various coronary *interventions such as CABG.*
    - *Less likely* to be referred to cardiac rehab.
    - *Unconscious bias*. (*Reference*: University of Sydney professor Clara Chow, cardiologist at Westmead hospital.)

PROJECTIONS

- *US*: *30% increase* in number of people over next 20 years with CVD. *45.1% population* (*130 million people*). (*Reference*: American College of Cardiology 2019)

IMPACT OF HEALTH ILLITERACY

- *International Society for Vascular Health*, "Vascular Health and Risk Management 2006". "We will need to *address the health literacy problem* in order to make *the next great advance* in postponing cardiovascular disease".
- HRRP: Coach patients on discharge instructions and self-management. Improve patient education. Confirm patient comprehension.
- *US*: *USD$29 billion pa in additional annual CVD healthcare costs* attributable to poor health literacy. (*Reference*: NCBI 2006 figures)
- *US*: *90 million people* health *illiterate*. (*Reference* for dot points above: *International Society for Vascular Health*, "Vascular Health and Risk Management 2006)
- *US*: health illiteracy among *indigent and minority patients* in urban areas: *>80%* (*Reference*: Taking the Time to Care: Empowering Low Health Literacy Hospital Patients with Virtual Nurse Agent http://relationalagents.com/publications/CHI09.VirtualNurse.pdf)

- 60% decreased medications adherence. (Reference: Health Literacy and Cardiovascular Disease: Fundamental Relevance to Primary and Secondary Prevention: A Scientific Statement From the American Heart Association. https://www.ahajournals.org/doi/full/10.1161/CIR.0000000000000579)

- *Patients forget between 40 and 80 percent* of what the doctor tells them as soon as they leave the doctor's office. More worrisome, though, is the fact that *50% of what patients do remember, they remember incorrectly*. (*Reference*: Building the Case for Health Literacy. National Academies of Sciences, Engineering, Medicine. 2018)

- *Australia*: *41%* population have adequate health literacy. *60% population* deficiencies in health literacy. (*Reference*: Australian Bureau of Statistics 2008)

MEDICAL LIABILITIES DUE TO HEALTH ILLITERACY

- A growing number of malpractice cases have been settled in favor of *patients* who were not appropriately informed about medical decisions.
- *Poor communication or miscommunication* between physician and patient is the *leading reason* for patient dissatisfaction, which increases the risk for lawsuits.
- Health care professionals may be held liable for errors due to miscommunication and lack of patient understanding that result in harm to patients.
- *Patients who miss appointments may have a viable lawsuit* if they can prove their failed appointment resulted in harm due to a doctor's unclear, inadequate or omitted instructions and/or advice.
- "*Continuum of confusion*"

(*Reference*: American Medical Association: Health Literacy and Patient Safety: Reducing the Risk by Designing a Safer, Shame-Free Health Care Environment 2007. *EXCELLENT REFERENCE*).

- The average *250-bed hospital* spends between *$300,000 and $1 million annually defending* medical malpractice claims. This is not for paying the claims.
- U.S. hospitals spend between *$173 million and $624 million annually on legal fees* associated with *poor communication*

(*Reference*: Building the Case for Health Literacy. The National Academies of Sciences, Engineering and Medicine. 2018. *EXCELLENT REFERENCE*)

THE COSTS OF NON-ADHERENCE TO MEDICATION AND HEALTH CARE REGIMES

US – non-adherence results in:

- *125,000 deaths* per year from cardiovascular disease.
- *10 percent* of all hospital admissions
- *23 percent* of all nursing home admissions
- *112 million unnecessary medical visits*
- *Extra $300 billion per year* in excess spending to nonadherence

(*Reference*: American Medical Association: Health Literacy and Patient Safety: Reducing the Risk by Designing a Safer, Shame-Free Health Care Environment 2007. *EXCELLENT REFERENCE*).

- *Communication (31%) was one of the top three contributing factors* to mal practice liability (MPL) - other two being judgment and technical issues. Communication between patient/family and providers ranged from *15% to 22%.* (*Reference*: Medical Malpractice in America: a 10-Year Assessment with Insights. CRICO 2018 CBS Benchmarking Report.)

CVD DIRECT MEDICAL COSTS

- *US*: 2016: *USD$555 billion* per yr. *2035*: *USD$1.1 trillion per yr* (*Reference*: American Heart Association. CVD: A Costly Burden for America – Projections through to 2035. 201)
- *Australia*: *AUD$8.8 billion* per yr ~ *12% total health expenditure* (*Reference*: Australian Heart Foundation 2018)

30-DAY READMISSION RATES:

- *US: 16.1% 30-day readmission rate; 90-day readmission rate 24%. (Reference:* "Coronary artery bypass graft readmission rates and risk factors - A retrospective cohort study" 2018. NCBI
- *Australia: 16.7% 30-day readmission rate; 40.2% 90-day readmission rate.*

UNPLANNED READMISSIONS

- *25% of patients* have *unplanned* readmissions. (*Reference*: Journal of the American College of Cardiology (March 2019)

MEDICARE READMISSION PENALTIES

(Reference: https://khn.org/news/hospital-penalties/ - "Look Up Hospital Penalties"

- **Maximum penalty: 3% reduction** of a hospital's payments for **all Medicare admissions** – not just readmissions.
- **Average hospital penalty** (among penalized hospitals only) was -0.74%
- 2018: 80% of 3241 hospitals CMS evaluated face penalties. (*Reference*: Advisory Board. 2017)

SAMPLE HOSPITAL DATA:

- Number Of Heart Procedures Per Year – SAMPLE HOSPITAL (*Reference*: SAMPLE HOSPITAL website 2019)
  - More than *550 open-heart procedures per year*.
  - *12,000 cardiac procedures* per year

- Medicare Readmission Penalties
  - 2015: *SAMPLE HOSPITAL was fined $942,000* in Medicare penalties 0.67%
  - 2016: 0.86%
  - 2017: 0.66%
  - 2018: 0.41%
  - 2019: 0.11%

- Inpatient Surgery and Procedures Costs At SAMPLE HOSPITAL (2011 figures)

  - Average amount *charged by SAMPLE HOSPITAL* for major cardiovascular: *$55,441.00*
  - Average amount paid by Medicare to SAMPLE HOSPITAL for major cardiovascular procedures without major complications: *$20,141.00*

- Litigation Costs
  - SAMPLE HOSPITAL: *$5 million pa* (source: SAMPLE HOSPITAL)

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UNITED KINGDON

(*Reference*: British Heart Foundation website 2019)
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- *7.4 million* people living with CVD
- *170,000 deaths* per year – *28%* of all deaths
- Healthcare costs relating to heart and circulatory diseases are estimated at £9 billion each year.
- *5 million adults* are "functionally *illiterate*"

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NEW ZEALAND

- *186,000* people living with heart disease.
- *33%* of all deaths.
- Deaths from cardiovascular disease (CVD) among *Māori* are more than *twice* that of non-Māori
- *4 out of 5 Māori males* and 3 out of 4 Māori females have *poor health literacy* skills

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AI AND TECHNOLOGY TRENDS

- AI Virtual Nursing Assistants: *$20 billion* through to 2026 (Accenture).

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DEMOGRAPHICS AND USE OF TECHNOLOGY

Technology Use and Confidence in Cardiac Rehabilitation Patients: Survey of Patients in Australia

- *Participants (mean age 69 years)were comfortable with the use of smartphones and make wide use of apps, suggesting the higher mean age of the CR population is a lesser barrier to the potential use of smartphone apps than assumed.*

US Smartphone User Penetration
(Reference: eMarketer, May 2018)

- *76%* of people aged 55-64 years, used a smartphone
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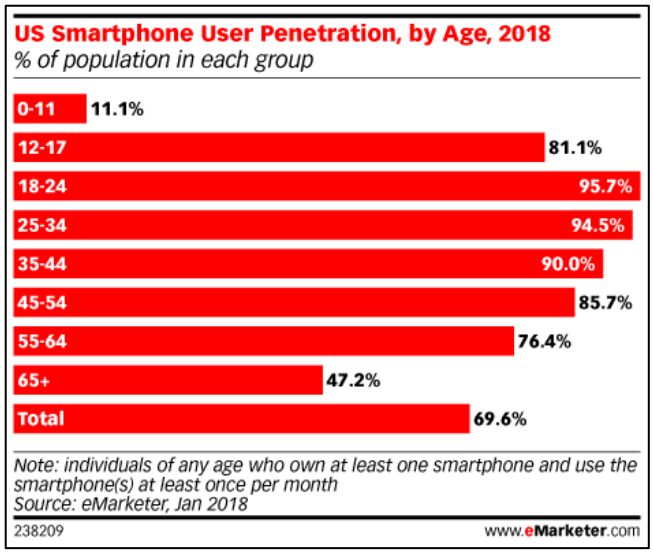
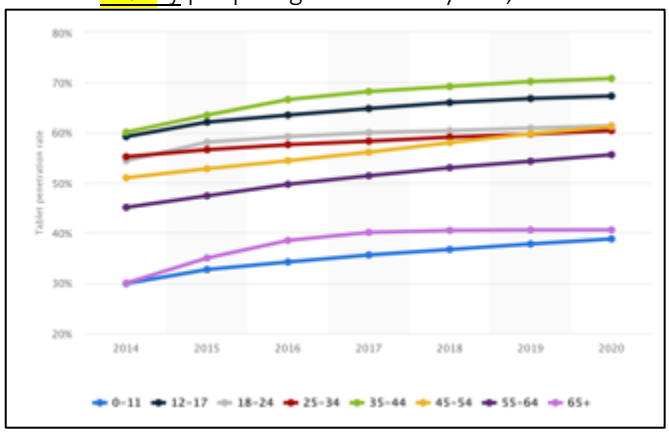


Tablet user penetration as share of population in the United States by age group from 2014 to 2020
(Reference: Statista)

- *60% of* people aged 45 to 54 years, used a tablet



QUOTES

SimCoach – DARPA Report. 2017
US Service Personnel being Assessed for Symptoms of PTSD

- *"Individuals are more comfortable disclosing to an automated virtual human interviewer than its human counterpart."*
- *"...virtual human interviewers allow simultaneous use of two techniques for eliciting disclosure that would otherwise be incompatible; they afford anonymity while also building rapport."*

Boston University Medical Center – Louise the Virtual Nurse part of Re-Engineered Discharge (RED) Project

- *"74% of hospital patients said they preferred receiving their discharge instructions from the virtual nurse, rather than their human doctors or nurses."*

What patients said:

- *"It's more helpful than talking to a person; it's just like the nurse, but she explained everything to the 'T'. "*
- *"Sometimes doctors just talk and assume you understand what they're saying..."*

Virtual Health Adventures. Used avatars in virtual world of Second Life® to provide evidence-based health information for individuals with upper and lower limb amputation(s), their families, and the clinicians

- *"Scientific evidence that what the avatar does, translates to real life.*

KEY RESEARCH BASED FACTS WITH LINKS

AHA Presidential Advisory

(2011)

https://www.ahajournals.org/doi/pdf/10.1161/CIR.0b013e31823b21e2

Each year, an estimated 785 000 Americans will suffer a new myocardial infarction (MI; heart attack), and nearly 470 000 will have a recurrent attack

Only 14% to 35% of heart attack survivors and 31% of patients after coronary bypass grafting surgery participate in a CR/SPP

Lack of accessibility to program sites and lack of insurance coverage contribute to the vast underuse of cardiac rehabilitation services

...low patient referral rate, particularly of women, older adults, and ethnic minorities

...many patients who are referred do not enrol in a program.

...34% of those referred actually enrolled

...Many who enrol do not complete the full course

****** Frequently, multiple barriers coexist, and single modifications of CR/SPP addressing a particular barrier (eg, implementation of an automating referral system to prevent referral bias) may not significantly improve enrollment rates. *****

participation in traditional CR/SPP can be increased by as much as 18% to 30% with the use of multifaceted patient-targeted strategies...

The impact of health literacy on cardiovascular disease

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1994011/pdf/vhrm0204-457.pdf

"Vascular Health and Risk Management 2006" Official journal of the **International Society for Vascular Health (ISVH)**

"Vascular Health and Risk Management" is an international, peer-reviewed open access journal focusing on the maintenance of vascular health, disease prevention, risk factors, therapeutics, monitoring and risk management of vascular disease and its sequelae

****** We will need to address the health literacy problem in order to make the next great advance in postponing cardiovascular disease. ******

DEFINITION: The American Medical Association (AMA) describes health literacy as "... a constellation of skills, including the ability to perform basic reading and numerical tasks required for functioning in the health care environment"

...Most health care material was written at a 10th grade reading level - one in five Americans reading at or below the 5th grade level.

One of the major barriers to improving patient knowledge of cardiovascular disease is that the education material ...- only 10% were written at the 8th grade level or below – some still offering college level cholesterol patient education material

...excess of $29 billion dollars in additional annual health care costs attributable to poor health literacy skills...

...90 million people in the United States exhibit less than adequate health literacy skills.

...70 million Americans suffer from cardiovascular diseases, it is certain that every physician's practice is affected by health literacy issues.

NUMERACY:

...cardiovascular diseases are diseases of numbers - blood pressure readings, lipid levels, how well patients understand the implications of their test results may influence their adherence to therapy.

Without a basic numeracy level, one cannot identify how many pills to take from a bottle, when doctors' appointments are scheduled

Specific numbers for laboratory values "held little value"...information was often lost in the translation from medical language to lay language

The less able patients were to read the labels, the more likely they were to be seen in the ED...

Beware the web...

...must be wary of referring patients to sources such as the internet, if we have not checked for appropriateness. One study found that greater than 80% of the web site material found on 37 non-prescription medicines was written on average at a 10th grade reading level.

apps for Cardiovascular disease

...the role of avatars in personalisation

(2017 - Australian reference – University of Sydney)

https://healthmanagement.org/uploads/article_attachment/hm-v17-i1-neubeck -cardiovascularapps.pdf

Gaming apps make up a large proportion of time spent online.

Avatars are frequently, and successfully, used in gaming.

At least 70 percent of people in the UK have a gaming app on their phone, and women of all ages now game more than men.... this is particularly important, because women are less likely to go to cardiac rehabilitation, but may use an app more readily... apps make games less threatening, and gamification has been successfully used to improve health

Personalisation

....personalisation appears to be a critical element of the success of apps in this field. When researchers from the TEXTME study interviewed participants, they found that the participants imagined that the friendly research assistant who had recruited them was personally sending individual text messages (redfern et al. 2016).

It seems that the more apps can be personalised, the more relevant and meaningful they become to us (neubeck et al. 2015).

...although something as simple as text messaging has been successful in achieving improved cardiovascular risk factors, it is critical to understand that a person-centred element is likely to be important in ongoing success and is critical in delivering healthcare interventions. it is possible that avatars could convey a sense of that person-centred support.

Co-Design and Cultural Considerations

Cultural relevance is extremely important. it is easy to dismiss information if the people who give it are perceived as 'not like me'. avatars have the advantage of being tailored to be culturally relevant....

...avatars varied in relation to gender and skin colour so that users could select the avatar that appealed to them most...

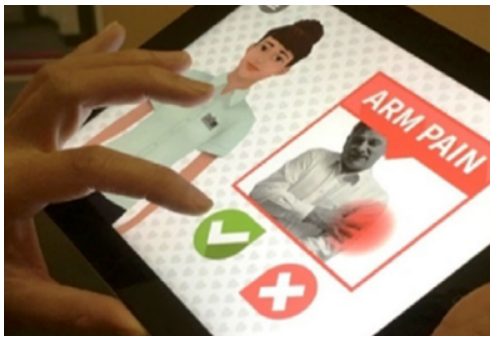
Young people were also involved from the beginning in designing the intervention, something the authors conclude was essential to making the final intervention acceptable to those it was designed for...

...It is imperative that when apps are developed for diverse cultural backgrounds, people of the relevant culture are involved throughout

An avatar-based education application to improve patients' knowledge of and response to heart attack symptoms: A pragmatic randomized controlled trial protocol

(Flinders University, South Australia – 2018)

https://www.researchgate.net/publication/325859149_An_avatar-based_education_application_to_improve_patients%27_knowledge_of_and_response_to_heart_attack_symptoms_A_pragmatic_randomized_controlled_trial_protocol



Picture: The SAVE App.

The SAVE app on a handheld computer tablet. The content of the SAVE app is divided into four sections: (a) heart attack warning sign quiz; (b) heart attack signs and symptoms; (c) what to do when having a heart attack and (d) heart attack action test.

Aim: To evaluate the effectiveness of an interactive, avatar-based education application to improve knowledge of and response to heart attack symptoms in people who are at risk of a heart attack.

Conclusion:

Avatar-based education has the potential to overcome the challenge of delivering vital but complicated medical information to patients. In addition, it seems likely that it can readily be used for other conditions and for people from diverse cultural and linguistic backgrounds.

Avatar-based patient education has the potential to improve the delivery of patient education and improve clinical outcomes.

By addressing the barriers of literacy and engagement, we believe this avatar-based education application has the potential to significantly enhance teaching and learning and clinical outcomes in people who experience a heart attack.

Using modern computerized tools such as animation and video, an avatar can enhance learning by helping to explain complicated medical information while mimicking real human interaction, which facilitates communication and understanding

Stats

It is estimated that 17.7 million people worldwide died from cardio-vascular disease (CVD) in 2015 (WHO 2017) and that 75% of such deaths are due to heart attack or stroke (WHO 2011).

Related Article: "Play avatar 'Cora' in computer games to prevent heart attacks"

https://www.adelaidenow.com.au/news/south-australia/play-avatar-cora-in-computer-games-to-prevent-heart-attacks/news-story/1c9b220b50f2ec6008983489b237942b

- The tablet app aims to replace brochures and be more engaging for people to learn about symptoms, in particular people who have trouble with written English.
- 47 per cent of Australians suffering from functional illiteracy
- Design took in factors including the avatar's voice tone.
- In future people will be able to choose their own avatar, including males which will work better for some cultures where men prefer to talk to men about such thing
- The Heart Foundation-funded project will give away the app for free once the trial is evaluated.

Reporting Mental Health Symptoms: Breaking Down Barriers to Care with Virtual Human Interviewers

DARPA – October 2017

This work was supported by DARPA under contract W911NF-04-D-0005 and the US Army

https://www.frontiersin.org/articles/10.3389/frobt.2017.00051/full

Background

A common barrier to healthcare for psychiatric conditions is the stigma associated with these disorders. Perceived stigma prevents many from reporting their symptoms. Stigma is a particularly pervasive problem among military service members, preventing them from reporting symptoms of combat-related conditions like posttraumatic stress disorder (PTSD). However, research shows (increased reporting by service members when anonymous assessments are used. For example, service members report more symptoms of PTSD when they anonymously answer the Post-Deployment Health Assessment (PDHA) symptom checklist compared to the official PDHA, which is identifiable and linked to their military records.

To investigate the factors that influence reporting of psychological symptoms by service members, we used a transformative technology: automated virtual humans that interview people about their symptoms. Such virtual human interviewers allow simultaneous use of two techniques for eliciting disclosure that would otherwise be incompatible; they afford anonymity while also building rapport.

We examined whether virtual human interviewers could increase disclosure of mental health symptoms among active-duty service members that just returned from a year-long deployment in Afghanistan. Service members reported more symptoms during a conversation with a virtual human interviewer than on the official PDHA. They also reported more to a virtual human interviewer than on an anonymizedPDHA. A second, larger sample of active-duty and former service members found a similar effect that approached statistical significance.

Because respondents in both studies shared more with virtual human interviewers than an anonymized PDHA—even though both conditions control for stigma and ramifications for service members' military records—virtual human interviewers that build rapport may provide a superior option to encourage reporting.

Key Points

- Individuals are more comfortable disclosing to an automated virtual human interviewer than its human counterpart.
- Rapport has an impact on self-disclosure above and beyond anonymity.
- The benefits of virtual human administrated mental health assessments could be substantial.
- Virtual human interviewers to have more interactive conversations with users, in which questions about the PTSD symptoms can be embedded. Having such an interactive conversation is critical because, while anonymity is beneficial, building rapport with respondents can also increase reporting
- Verbal and non-verbal behaviors that help to build rapport; and subsequent research has shown that resultant rapport leads interlocutors to disclose more eg utterances, intonation, gestures, facial expressions.
- Traditional computerized self-assessments and other anonymized forms lack any human element - do not evoke the same feelings of rapport - when there is not a human or human-like agent present in some way, shape, or form, people feel less socially connected during the assessment.
- While rapport-building seems contrary to anonymity, the use of virtual human interviewers may provide a solution that allows for both anonymity as well as rapport-building.
- Virtual human interviewers could be considered as an assessment strategy in other areas (e.g., financial planning) where people may perceive at least some stigma, and therefore may be tempted to under-report certain values (such as debt) even though honest information is essential for practitioners to give clients sound advice.
- *"...just having an anonymous online form appears not to be a sufficient "technological leap" to maximize self-disclosure".*
- The benefits of virtual human administrated mental health assessments could be substantial.

Project Re-Engineered Discharge is a research group at Boston University Medical Center

http://www.bu.edu/fammed/projectred/index.html

http://www.bu.edu/fammed/projectred/meetlouise.html

Virtual patient advocates are currently being tested in conjunction with the RED

Louise is one of our Virtual Patient Advocates. In concert with the After Hospital Care Plan, Louise assists the Discharge Advocates in teaching patients about components of their care, such as their prescribed medications, follow-up appointments and diagnoses. Louise was created based on the communication styles of nurses, which patients are receptive to. Her dialogue is tailored for each patient based on the information entered into the workstation. Currently, the effectiveness of Louise is being tested as part of the RED-lit project.

Prof Brian Jack, *creator of "Louise"*: "*Patients in the hospital are not at the top of their cognitive game - sick, feverish, or sleep-deprived people are unlikely to comprehend first-time instructions about prescriptions or at-home care procedures."*

Use Case

- Part of discharge process – for use in patient's hospital room – stand-alone in which all the patient data is entered via the workstation.
- Patients interact with Louise by using a touch screen display that is mounted on an articulated arm so that patients can interact with the discharge system from a variety of positions in their hospital bed
- "Louise" - simulates face- to-face interaction between a patient and a nurse.
- Louise can talk because she uses synthetic speech and synchronized animation
- Patients can respond to her by touching what they want to say on the touch screen.
- The language used by Louise is dynamically composed based on each patient's medical data and questions asked.
- Therapeutic alliance.

What Do Patient's Say?

- Pilot study - 74% of hospital patients said they preferred receiving their discharge instructions from the virtual nurse, rather than their human doctors or nurses.
- "*It's more helpful than talking to a person; it's just like the nurse, but she explained everything to the 'T'. "*
- *"Sometimes doctors just talk and assume you understand what they're saying..."*

Stats

- Discharge - 38 million hospital discharges in the U.S. in 2003 alone
- Virtual discharge system could save our healthcare system over $5B per year – reduces re-hospitalisations by 25%
- 49 US states wanting to implement some part of the discharge protocol
- Ninety million Americans (36% of adults) have inadequate health literacy - reduced ability to read and follow directions in the healthcare environment ... higher healthcare costs ... higher rates of hospitalization and re-hospitalization.

Related Article:

Taking the Time to Care: Empowering Low Health Literacy Hospital Patients with Virtual Nurse Agents

http://relationalagents.com/publications/CHI09.VirtualNurse.pdf

Key points

- Hospital discharge typically only lasts less than 8 minutes, is intended to transform patients from completely passive recipients of care to being completely responsible for all aspects of their health care.
- Virtual nurse spends approximately 30 minutes with each patient.
- Average patient being discharged with ten medications and multiple follow up appointments.
- The discharge is even more hazardous for patients with inadequate health literacy.
- It is anticipated that, as with many advances in universal access, it will prove beneficial for all patients, regardless of health literacy level. Several studies have shown that when medical instructions are designed for patients with inadequate health literacy, all patients benefit from the improved clarity.
- ECAs can also consistently evaluate patient comprehension of the material presented. Physicians infrequently evaluate patients' understanding, and when they do it is mostly to simply to ask "do you understand?" without waiting for a reply
- Multi-disciplinary co-design – in-situ, video interactions, observations, visits – conversation design, conversational behaviours, scaffolding – studies involved 49 participants aged 20 to 75, 47% categorised as having inadequate health literacy.

Stats

- Health illiteracy – American adults: 36%. Among indigent and minority patients in urban areas: over 80%

Longitudinal Remote Follow-Up by Intelligent Conversational Agents for Post-Hospitalization Care

(MJ NOTE: THIS IS AN EXCELLENT PAPER – TALKS ABOUT EMBODIED CONVERSATIONAL AGENTS AND THE STUDY OF ACTUAL CONVERSATIONS)

Presented by CA Pfeifer, L., Bickmore, T. at AAAI 2011 Spring Symposium on Artificial Intelligence and Health Communication, Palo Alto, 2011.

Northeastern University

http://www.bu.edu/fammed/projectred/publications/AAAISpring2011.pdf

In this work, we describe our design for an Embodied Conversational Agent (ECA) system for use at home for longitudinal, post-hospitalization follow-up.

ECA – provide compelling interface modality for patient education

1. Easy to use, requiring no prior computer experience.
2. Based on computational models of natural human behavior, which allows for rapport-building and empathy, important factors in positive health outcomes
3. ECAs can provide health information that is adapted to the particular needs of a patient and to the immediate context of the conversation – patients feel free to take as much time as they need.
4. Successfully used in underserved populations such as older adults, and people with inadequate health literacy

Design

- Audiotaped a series of follow-up conversations between the RED project pharmacist and recently discharged hospital patients

- Content and discourse analysis of transcripts from these sessions

Condition Review
Ok, so first can you tell me the main reason why you were in the hospital? *Ummm, I was having shortness of breath…and there was also, they found fluid on my lungs which might have been caused by a virus and it might have affected my heart.* Perfect, yep, right that's exactly the information that I got. Because of that virus around your heart, maybe your heart wasn't pumping as efficiently and your blood pressure was high, so they said that maybe you had some cardiomyopathy. That would be the diagnosis.

Medication Review
So how do you remember to take your medicines? Are pill boxes usually… *I just line 'em up. What I do is I put my diabetes medicine on one side, and then the others I just line 'em up and take them one-by-one.* OK, and that system seems to be working for you? *Yeah.* So whenever you're ready I'll have you just take one medicine at a time and we'll go through 'em. I'll compare it to the list I have here and I'll ask you a couple questions about each medicine. So, in any order that you want… *Fffffurosemide….*Yep Furosemide good. *I think this the fluid pill.* That is the fluid pill. *I take it in the morning.* OK and how many tablets do you take in the morning? *One.*

Side-Effect Discussion
Any side effects from this one? This is probably causing your headache, yeah. *It's not that bad it's like in the back here.* OK, how bad is the headache and how often does it come? *It's not too bad, it's tolerable, just annoying.* OK, so on a scale of say zero to ten, zero is no pain and ten is like the worst headache of your life, where would you put it? *Three.* You would put a three, ok and when you get the headache what do you usually do?

Appointment Discussion
Now when are your upcoming appointments? *I have one with the heart specialist on the 9th, and one with my primary care on the 20th.* Perfect so on the 9th you're going to see Dr. _____ the cardiology doctor at nine in the morning. Do you know where to go for that? *Yep.* Are you going to be able to make that appointment? *Yes.*

Figure 2. Sample patient-pharmacist dialogue for routine aspects of the conversation (edited for grammar)

- Teach back and co-design – testing patient's understanding
- Repeated adaptive interactions