

MASTER

the digital human cardiac coach

use case and complexity framework

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use case complexity framework

Considerations for understanding risk and complexity in use cases

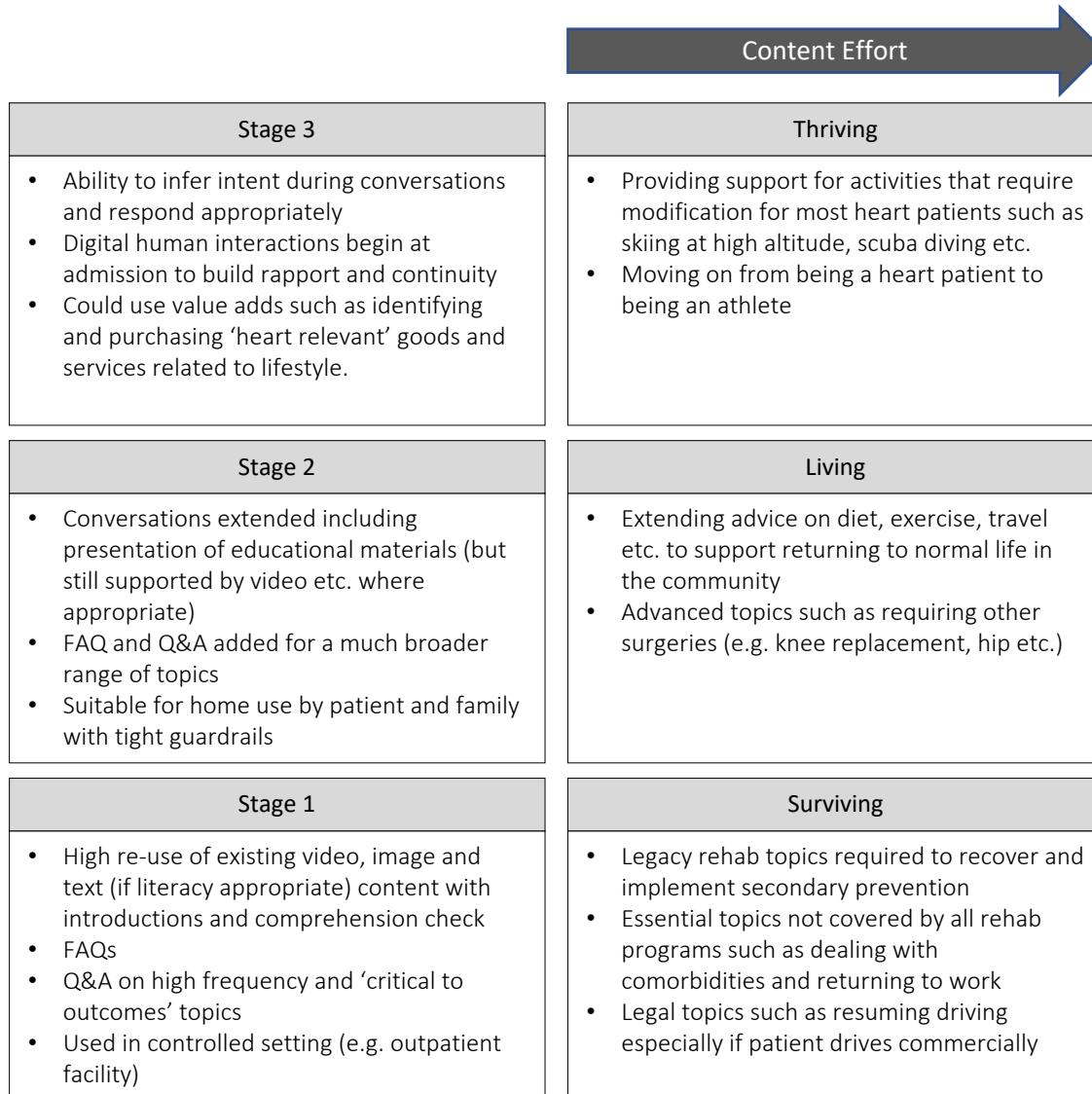
Business Factors					
External Regulation	No guidelines or regulations	General industry guidelines or International Standards - not enforceable	General industry guidelines (e.g. ANSI) relevant to license to operate and mandatory	Single regulation such as FDA or HIPAA	Multiple regulations such as FDA and HIPAA
Internal Policy	No guidelines or policy	Advisory policy or procedures - discretionary	Advisory policy or procedures - mandatory	Policy approvals required separate from process	Policy approvals embedded in process actions
System/Process Commonality	Globally common with UN or other standard	Globally common with national standards	Globally common with variants within nations	Differs from country to country but with some common roots	Differs between countries and even regions with few or no common roots
Language Factors					
Spoken Language	Non-colloquial English - USA, UK, Australia, New Zealand, Canada	Colloquial English - USA, UK, Australia, New Zealand, Canada	European Union countries foreign language but strong English usage	Asian languages with little resemblance to English and population non-English speaking	Non-English with strong regional variations
Culture	Monoculture largely based on western values e.g. USA, Australia, UK, NZ, Canada	Large common non-western culture e.g. Chinese, Indian	Blended cultures with an indigenous element e.g. Malaysia	Indigenous culture common to most regions	Indigenous culture with distinct regional differences
Lexicon Complexity	Words and phrases in general use e.g. relating to lifestyle	Words and phrases used in a specific domain or use case but that have had wide exposure in the media	Words and phrases used in a specific domain or use case that would be understood by a minority of the general population	Words and phrases that are in general use but that have specific legal or policy meaning within a service delivery program	Complex words and phrases internal to an industry and seldom seen by the public
Domain & Use Case Factors					
Digital Human Role	Meet and greet in controlled environment	Assistant	Advisor	Coach	Influencer
Conversation Complexity	Prepared information in response to standard commands	FAQs and advice in response to anticipated questions	Chained conversations within use case	Ability to infer questions within use case	Free flowing conversation on multiple use cases within domain
Empathic Interaction	Common facial gestures based on content	Add contextual empathy	Add infer user mood from language	Add infer user mood from visuals	Add user specific empathy based on history
Consumer Persona Variability	Single user with mapped personality and level emotional state	Multiple users with similar personality and level emotional state	Multiple users with similar personalities but variable emotional states	Multiple users with different personalities but level emotional state	Wide range of personalities and emotional states
Technology Factors					
Technical Expansion	Conversation only	Added features and content such as text, images, video, maps	Add integration to email, messaging, schedules etc	Add bounded machine learning	Add digital human to digital human collaboration
Avatar to Ai Connectivity	Proven for digital humans	Integration exists but not for digital humans	Avatar and Ai components from same company	Avatar and AI components from different companies	Either or both components require R&D
Object Recognition	OCR of forms etc or recognition of simple objects	Simple objects combined with OCR (e.g. medicine labels and their containers)	Complex objects with/without OCR (e.g. clinical supplies and hospital equipment)	Facial recognition for security and emotional interpretation	Gesture analysis (e.g. reading signing from a patient)

examples of digital human cardiac coach use cases



use case A | cardiac rehabilitation

Complexity ↑



Health Topics	Health Topic Extensions	
About my condition	Understanding comorbidities	Dealing with comorbidities
Medications	Remember & track meds	Travelling with meds
Quitting tobacco	Specific support programs	Your family smoke
Diet	Dining out/take out	Healthy groceries & cooking
Exercise	Walking programs etc.	Community exercise
Psychology	Sleep	Family
Regular Immunisations (e.g. flu)	Others (e.g. pneumococcal)	xxxxx
xxxxx	xxxxx	xxxxx
Events	'Bucket List' Topics	
Returning to work	Exercising at altitude	
Resuming driving	Endurance events & HIIT	
Travel (esp. flying)	Water sports	
Prep for other surgeries	Weightlifting precautions	
Dealing with setbacks	Celebrating success	
xxxxx	xxxxx	
xxxxx	xxxxx	
xxxxx	xxxxx	

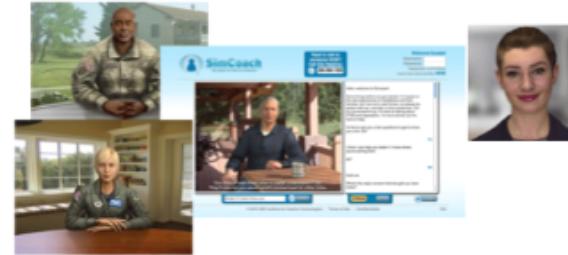
use case B | discharge from hospital

Complexity & Effort

Admission – Discharge - Rehab

- Digital human goes home with patient after discharge and supports transition to home life and rehab (manages gap to rehab if any)
- FAQs and Q&A on expected transition period questions – meds, eating, exercise, wound care etc. – explains at discharge and then supports these at home or post-acute care

The Digital Human 'Cardiac Coach' uses human realistic avatars, co-design, empathetic natural conversation and artificial intelligence to overcome literacy and numeracy barriers, and significantly increase rapport, trust, disclosure and commitment. Co-design has been proven by the Nadia project. The peer reviewed SimCoach PTSD counsellor has proven the ability to build rapport, trust and disclosure.



Admission to Discharge

- Digital human introduced to patient at admission and stays with them throughout confinement
- Rapport built over time enables richer discharge conversations at discharge
- Add presentation of standard video content e.g. what to expect first day at home (rapport better enables this interaction)

Many effective point e-health initiatives including web sites, applications, wearables, digital health ecosystems and virtual environments have been released but don't address the entire problem



Only Used for Discharge

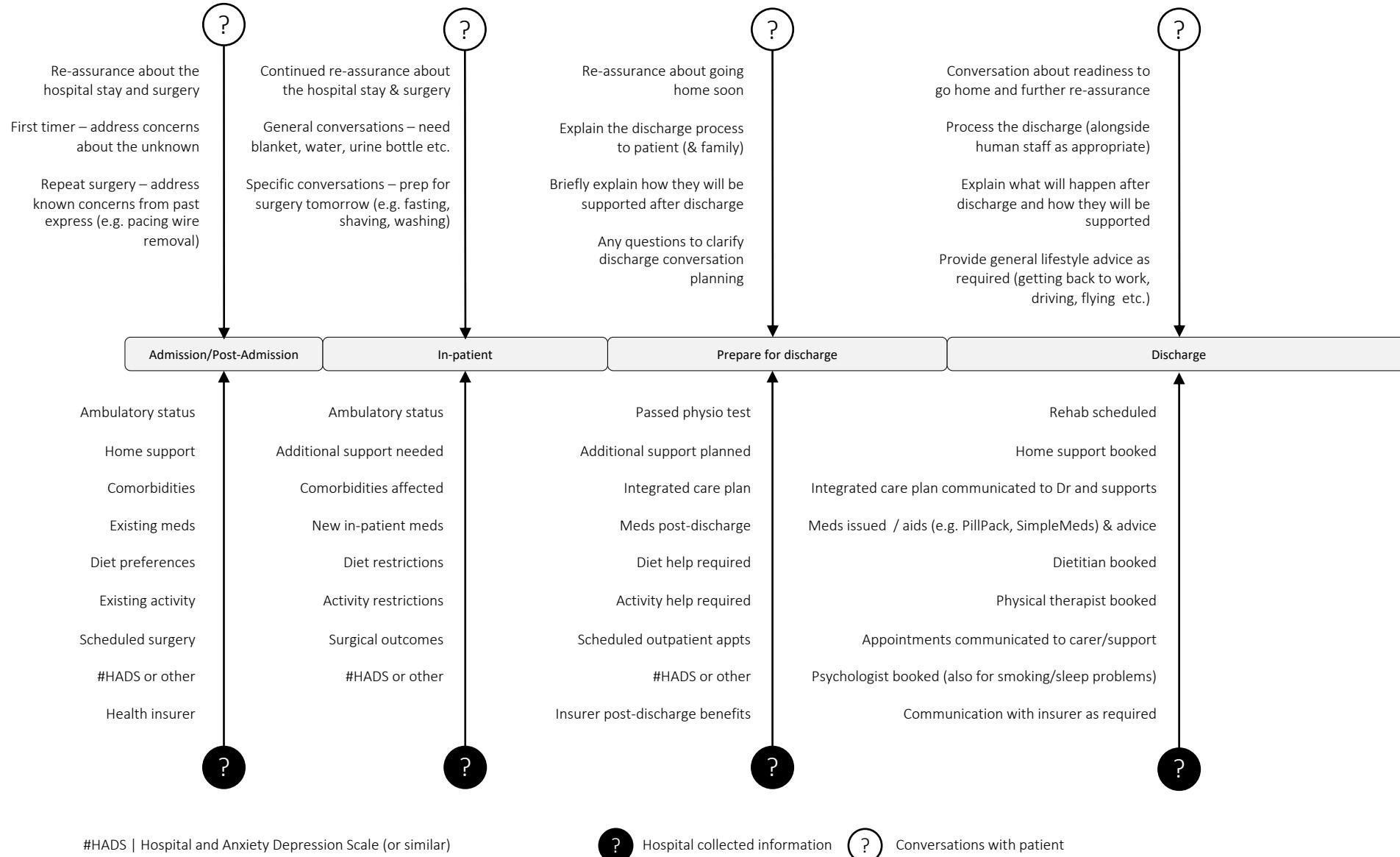
- Performs stand-alone tasks such as customer satisfaction
- Identifies additional actions for human discharge staff
- Motivates patient for rehab
- Other tasks as appropriate to reduce staff workload

Effective solutions for transition to post acute care have been described and developed



The problems with discharge processes and their effect on recovery and secondary prevention have been well researched and understood





#HADS | Hospital and Anxiety Depression Scale (or similar)

?

Hospital collected information

?

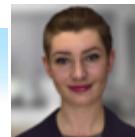
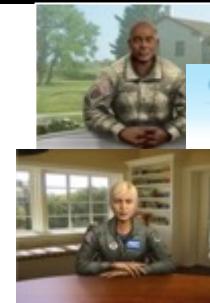
Conversations with patient

use case B | discharge from hospital

Complexity & Effort ↑

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The RED (Re-Engineering Discharge) project provides a repeatable capability with processes, data and technology to improve the PAC transition (Louise) but still doesn't fully address health illiteracy and innumeracy

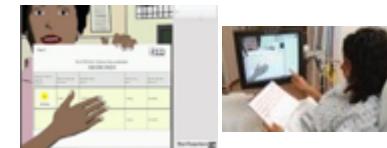
PROJECT RED
Re-Engineered Discharge

A Research Group at
Boston University Medical Center

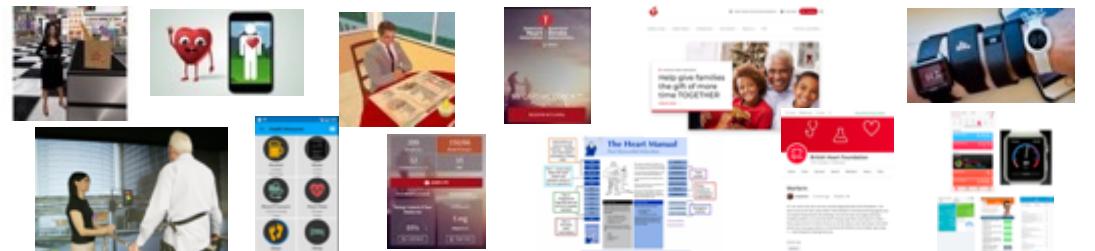
BOSTON MEDICAL
ENHANCED CARE, WITHOUT EXCEPTION.

BU Boston University School of Medicine

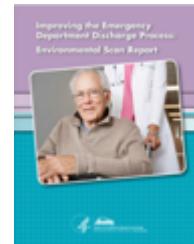
Funded by the Agency for Healthcare Research and Quality, National Heart, Lung and Blood Institute, the Blue Cross Blue Shield Foundation, and the Patient-Centered Outcomes Research Institute



Many effective point e-health initiatives including web sites, applications, wearables, digital health ecosystems and virtual environments have been released but don't address the entire problem



Effective solutions for transition to post acute care have been described and developed



A brief guide to developing criteria-led discharge

December 2017

This guidance supports the development of criteria-led discharge. Evidence suggests this should be led by the consultant with a multi-inter-disciplinary team and guided by evidence from national clinical guidelines and protocols.



The problems with discharge processes and their effect on recovery and secondary prevention have been well researched and understood

BJCS British Journal of Cardiovascular Surgery

Nursing assistance at the hospital discharge after cardiac surgery: integrative review

Frontiers in Cardiovascular Medicine

Perspectives of Post-Acute Transition of Care for Cardiac Surgery Patients

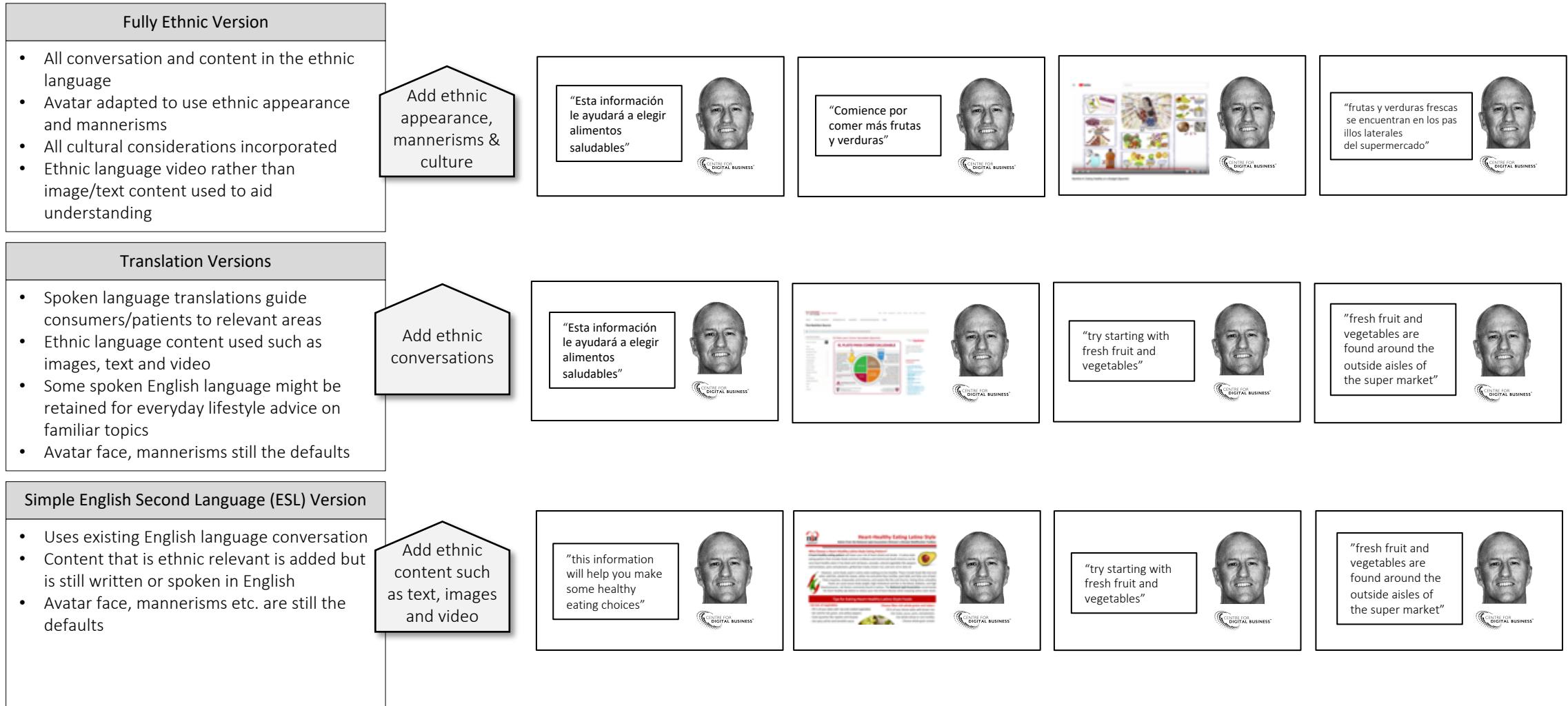
THE NEW ZEALAND MEDICAL JOURNAL

A national survey of cardiac rehabilitation services in New Zealand: 2015

The effectiveness of modern cardiac rehabilitation: A systematic review of recent observational studies in non-elective versus elective patients

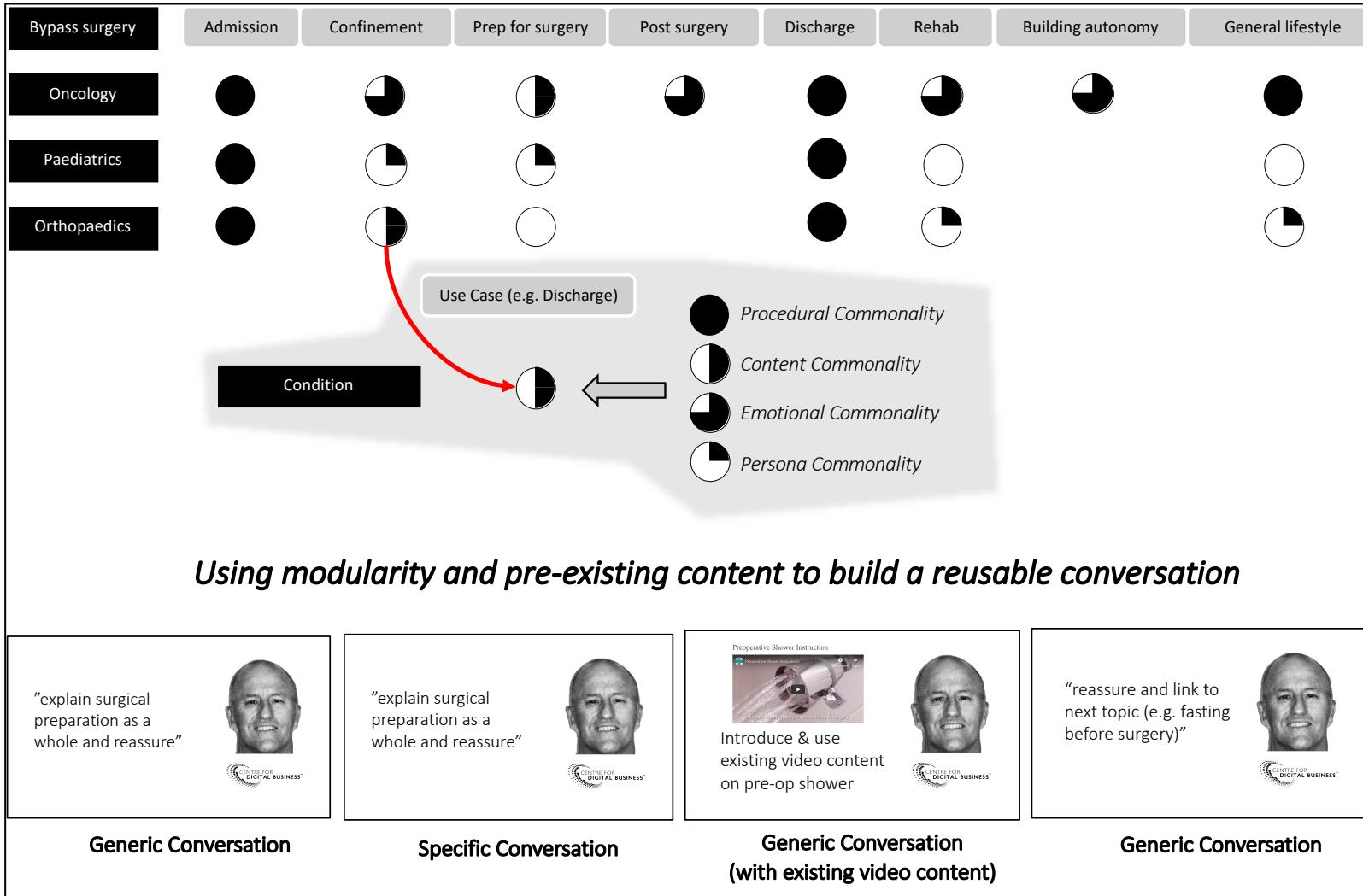
use case C | ethnic populations

Complexity & Effort



identifying and building for reuse

Identifying commonality to prioritise capability development and maximise reuse opportunities



why are digital humans important to health care? | explanatory notes

Capability Considerations

- There has been considerable evidence-based research and statistical tracking and analysis finding that cardiac rehabilitation is effective but:
 - Many patients suffer from barriers that either prevent them from attending or reduce its effectiveness.
 - There is no standard application of cardiac rehabilitation; in Australia it is typically 6 weeks and beginning weeks after discharge whilst in the USA it can be up to 12 weeks and might begin in hospital.
 - Organisations such as the Mayo Clinic have found that even the 12-week program can be insufficient, and there are research findings elsewhere that patient 'autonomy' in applying the recommended medication regime and lifestyle changes can take much longer.
- Telehealth (especially websites and apps) has been embraced to:
 - Improve availability
 - Provide some after rehab reinforcement
- The majority of the content on the websites and apps is text based and still fails to address the fundamental problem of patient health illiteracy. There is some use of video and images but even these are often confusing to patients.
- Augmented health is the 'next wave' of telehealth that seeks to shift the focus to what consumers want and need:
 - Health ecosystems that enable consumers to collect, manage and use their own health data. There can be educative and motivational effects and Apple and Google have far greater experience in designing simple user interfaces and systems than those behind many of the apps.
 - Virtual world or immersive technologies that have significant learning potential and, being graphical and distributed, can overcome many of the barriers to heart health. Mayo Clinic has been at the forefront of trialing these technologies.
 - Digital humans complete the augmented health tool set by offering empathic natural language conversations that build trust and lead to greater motivation and commitment. Digital humans also uniquely offer the advantage of being able to embed all of the other telehealth channels and provide context around them.

Codesign Considerations

- Codesign for health use cases should be both inward and outward facing. Codesign for consumers will focus on increasing their health outcomes. Codesign for medical and other staff should focus on reducing their workload to reduce burnout and improve their job satisfaction. Both of these are humanitarian applications.
- The approach to this is multi-faceted. There are many staff-consumer interactions that increase staff workload and stress that can be effectively handled by a digital human in both inpatient and outpatient settings. Even the need for conversation and reassurance that many patients feel when first admitted and their family have gone home can be met through interaction with the digital human. Importantly, capturing interactions through the digital human enables direct AI analysis of interactions that can improve staff job design.
- The digital human can also directly interact with staff. For example, digital humans could debrief nursing staff much as SimCoach debriefs soldiers with PTSD. They can also function as an assistant and even mentor to new nursing staff, or short-term contract staff brought in to fill a temporary staffing gap.
- Codesign from the get-go will enable identification of these opportunities and how to prioritise and realise them within the context of the overall digital human project.

health care digital human benefits - bridging the divide between “health care & health economics”

Health System – Commercial and Government

- Potential to increase for ALL patients regardless of their current barriers:
 - The number of patients receiving cardiac rehabilitation education.
 - The effectiveness of cardiac rehabilitation education programs.
 - Understanding of and adherence to medication regimes and lifestyle changes.
- These in turn can lead to (for government) and citizens:
 - Lower rates of premature death from heart disease.
 - Lower rates of repeat events and treatments (e.g. revascularizations).
 - Reduction in health budgets or increase in ability to fund other chronic diseases.
 - Reduced productivity loss to the economy.
- And for commercial sector health organizations (e.g. insurers and hospitals):
 - Reduced payout costs.
 - Reduced staff burnout.
- Improved health outcomes and greater brand awareness leading to:
 - increased membership,
 - Increased ability to attract quality staff and
 - Increased ability to attract grants and bequests.

Health Consumers

- Cardiac rehabilitation and rehabilitation available to all regardless of barriers.
- The most vulnerable, such as the homeless, have improved access to ‘face to face’ services as resources freed up elsewhere.
- Lower death rates and infirmity.
- Increased economic participation.
- Improved lifestyle.
- Lower adverse impact on family.
- Reduced carer burnout.

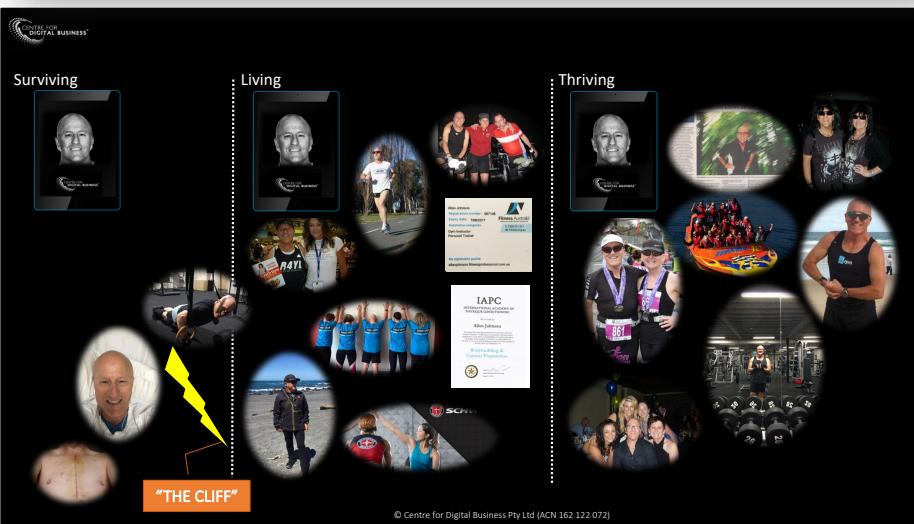
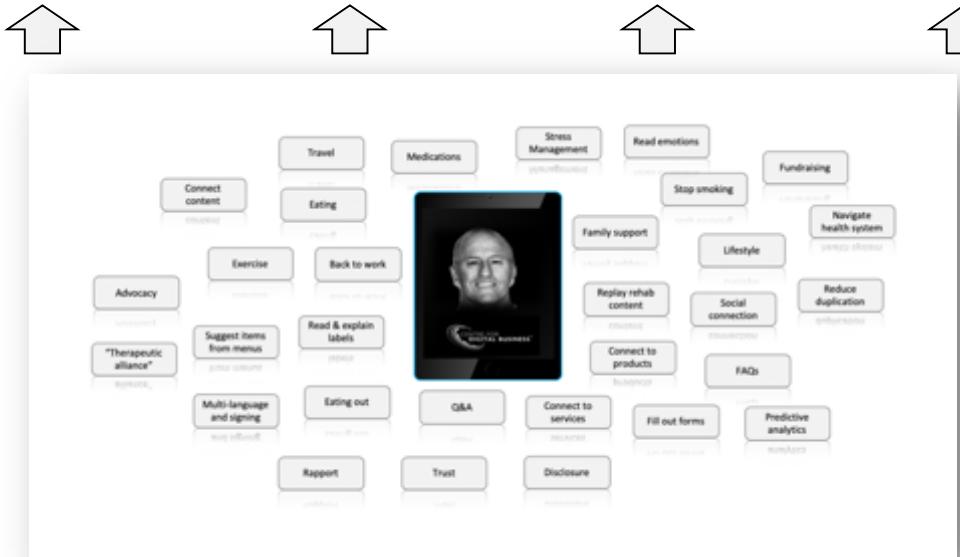
Capability Considerations

- Benefits can also result from the use of digital humans to drive standardization and even centralization of content development and management. For example, in Australia, most cardiac rehabilitation programs develop their own content even though it should be common across the board.
- To maximize productivity benefits a digital human project needs to be more than simply trying to identify how to transfer human tasks to the digital human. Rather it is how they can work alongside each other to maximize effectiveness.

Codesign Considerations

- Codesign increases the effectiveness of digital human implementations to increase positive outcomes.
- Codesign ensures that common conversations and content developed for cardiac health are available without modification for comorbidities such as cancer and mental health.
- Codesign leads to greater rapport and trust which in turn increase commitment to change.

what is the digital human cardiac coach?



*“...overcoming health illiteracy and other barriers
to build personal capacity and confidence to live a heart-healthy life...”*

- Cardiac Coach is a co-designed AI powered digital human containing a corpus/corpora and other functionality to achieve natural conversational interaction regarding heart health information and education for heart patients and their families.
- Cardiac Coach is intended to assist patients to understand primary prevention, cardiac events, hospitalisations and surgeries, recovery and secondary prevention and to support them in the implementation of these.
- Cardiac Coach is not automation of the current booklets given to heart patients which often fail to achieve adherence to the lifestyle changes and medication regimes required to prevent and recover from heart disease, events and surgeries.
- These booklets and structured website material are ineffective because of the high levels of health illiteracy amongst the heart patient community, especially amongst ethnic minorities and those with socio-economic and psycho-social disadvantage.
- Cardiac Coach is instead continuously available, accessible, understandable, updated and relevant to patient needs. Because it uses natural language conversations it overcomes the barriers of health illiteracy.
- It can be delivered direct to patients on desktops, kiosks or mobile devices or be used as an assistant by practitioners who are working with heart patients. These might include doctors, nurses, exercise physiologists, dietitians, pharmacists and psychologists.
- Cardiac Coach does not perform diagnosis nor recommend treatment.

origin of digital human cardiac coach | explanatory notes

Additional Information

- 'Patient 1' is Al Johnson, co-founder of the Centre for Digital Business.
- Al is a former Royal Australian Air Force (RAAF) aeronautical engineering officer and since leaving the military has worked around the world on business improvement and software projects.
- As part of Masters education, Al undertook early research into expert systems.
- Al had an emergency 5-way heart bypass on March 25, 2006 at Bellevue Hospital Seattle.
- He had two angioplasty procedures back in Australia only 9 months later when several of his grafts collapsed.
- On August 20, 2017 he had a 3-way bypass after the rest of his grafts closed. Because of his adherence to his medication regime and rehab recommended lifestyle changes his mammary artery graft was 'crystal clear' according to his surgeon. The surgeon and Al's cardiologist believe that the problems subsequent to his first bypass are related to the endoscopic saphenous vein extraction used in that surgery.
- Since his first surgery Al has been an active volunteer with cardiac rehabilitation at The Canberra Hospital, the National Heart Foundation Australia and Heart Support Australia.
- He has also given many talks on heart health to health students at the University of Canberra, to various health industry guilds and to community groups such as ACT Veterans Rugby.
- To assist his volunteer work Al has qualified as a Personal Trainer (registered with Fitness Australia), Heartmoves Leader, Rehab Trainer, Schwinn cycle instructor and body building coach. He has also volunteered extensively in the fitness industry to promote health in the community.
- Al is often approached by individuals undergoing heart surgery for advice and support.
- Al is an active fundraiser for various health charities.

Additional Information

- The digital human cardiac coach concept, use cases and application have been based on Al's 14 years as a heart patient; his professional systems engineering experience and training; and feedback and insights from other heart patients, medical professionals, allied health professionals.
- From Marie's experience with Nadia, common patterns and themes were identified:
 - Traumatized vulnerable people dealing with large bureaucracies and organizations.
 - People yearning for empathetic face to face conversational engagement.
 - Functional and health illiteracy.
 - Complex information provided in bureaucratic language.
 - Disabilities are a barrier to access.
 - People feeling stigmatized due to their situation.

what can the digital human cardiac coach do?

