



Multimedia Appendix 11 - Conceptual networks of clustered metaphors

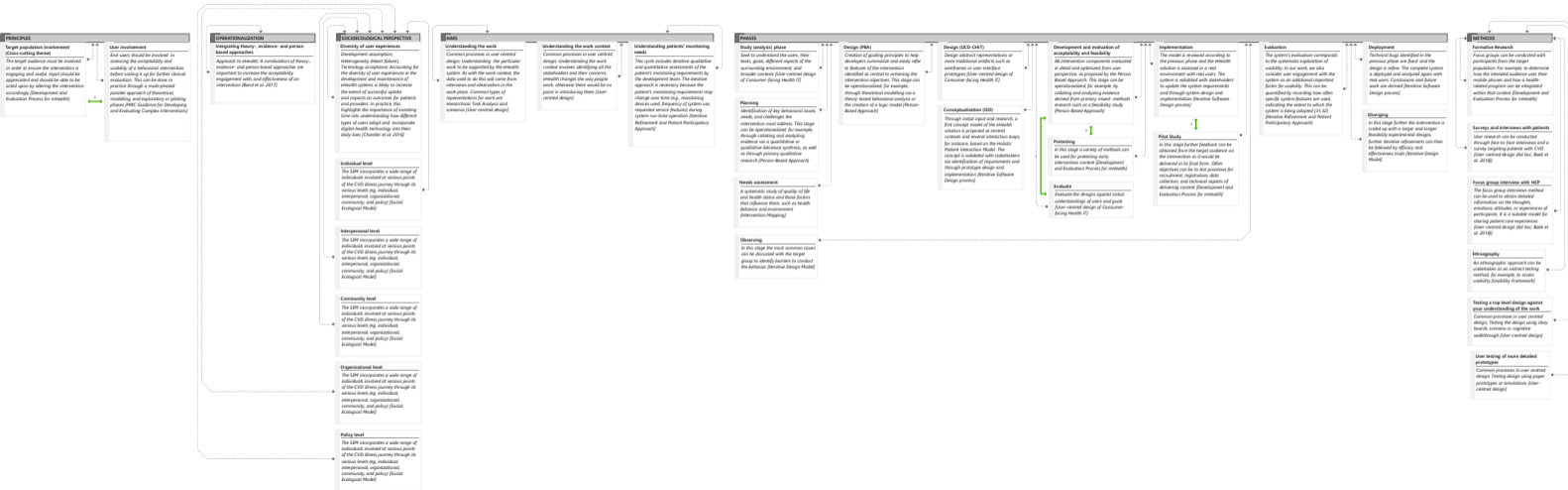
 Reciprocal translation (=)

 Refutational translation (<>)

Grey boxes are themes and organizers for the synthesis

eHealth is a participatory development process

Line-of-argument (Conceptual network)



eHealth development creates new infrastructures for improving health care, health, and well-being

Line-of-argument (Conceptual network)

OPERATIONALIZATION

Interdisciplinary methods

Development state-of-the-art; Limitations of study/project; There is a growing need to consider adopting methods from other disciplines rather than using deployment-evaluation cycles [54]. Theories, models, and methods to support this approach can be found in engineering and related sectors (e.g., use of factorial or fractionated evaluation designs that have been utilized well within the HCI sphere) [Walsh et al. 2018a]

SOCIOECOLOGICAL PERSPECTIVE

Organizational level

The SEM incorporates a wide range of individuals involved at various points of the CVD illness journey through its various levels (eg, individual, interpersonal, organizational, community, and policy) [Social Ecological Model]

Individual level

The SEM incorporates a wide range of individuals involved at various points of the CVD illness journey through its various levels (eg, individual, interpersonal, organizational, community, and policy) [Social Ecological Model]

Interpersonal level

The SEM incorporates a wide range of individuals involved at various points of the CVD illness journey through its various levels (eg, individual, interpersonal, organizational, community, and policy) [Social Ecological Model]

Community level

The SEM incorporates a wide range of individuals involved at various points of the CVD illness journey through its various levels (eg, individual, interpersonal, organizational, community, and policy) [Social Ecological Model]

Policy level

The SEM incorporates a wide range of individuals involved at various points of the CVD illness journey through its various levels (eg, individual, interpersonal, organizational, community, and policy) [Social Ecological Model]

AIMS

Tailored, personalized, and timely support

eHealth added value; eHealth state-of-the-art; Increasingly widespread access to the internet and mobile phones means that eHealth can be accessible to the majority of patients and can be used to provide information and support at any time the patient needs it. eHealth can empower patients by providing better access to personalized information and support for active involvement in treatment and self-management [Band et al. 2016]

Remote delivery of system refinements

Following delivery of the eHealth technology at the patient's home, remote refinements of the system can be initiated, thereby saving valuable human resources [Iterative Refinement and Patient Participatory Approach]

Facilitating conditions

Determinants of technology acceptance; Consumers' perceptions of the resources and support available to perform a behavior [Unified Theory of Acceptance and Use of Technology model]

Policy categories

Policy categories represent types of decisions made by authorities that help to support and enact an intervention [Behavior Change Wheel/COM-B model]

Service provision

Policy categories; Delivering a service [Behavior Change Wheel/COM-B model]

Guidelines

Policy categories; Creating documents that recommend or mandate practice [Behavior Change Wheel/COM-B model]

Social planning

Policy categories; Designing and or controlling the physical or social environment [Behavior Change Wheel/COM-B model]

PHASES

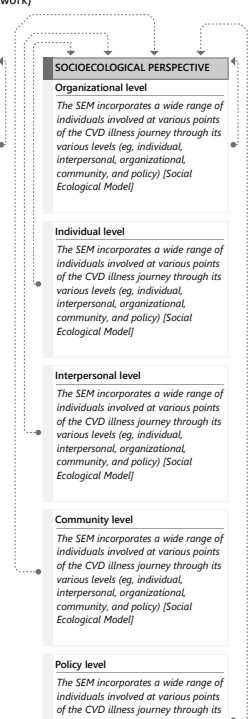
Conceptualization (DEP)

Stage of development where experts decide on the theoretical basis, review the evidence, and plan the development process. Brainstorming sessions can cover how to translate the theory and evidence into practical methods and techniques [Development and Evaluation Process for mHealth]

METHODS

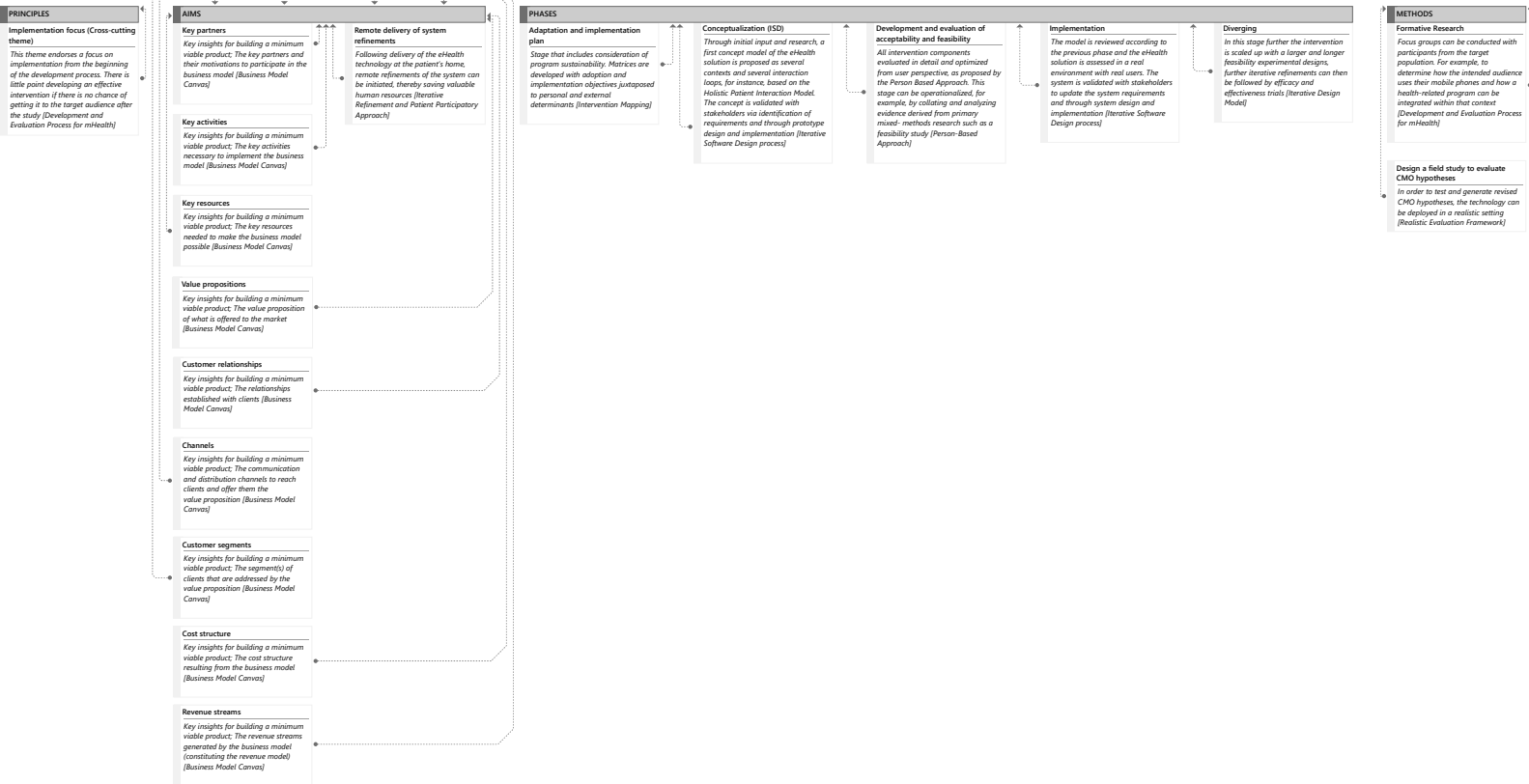
Program plan

Stage of intervention mapping that includes a description of the scope and sequence of the components of the intervention, the completion of program materials, and protocols for implementation [Intervention Mapping]



eHealth development is intertwined with implementation

Line-of-argument (Conceptual network)



eHealth development integrates theory, evidence, and participatory approaches for persuasive design

Line-of-argument (Conceptual network)

OPERATIONALIZATION

Integrating theory-, evidence- and person based approaches

Approach to eHealth; A combination of theory-, evidence- and person based approaches are important to increase the acceptability, engagement with, and effectiveness of an intervention [Band et al. 2017]

AIMS

Tailoring and personalization

Heterogeneity (CVD); An individual assessment (e.g., on psychological readiness for change) and tailored and personalized features can be useful to achieve health behavior change, to empower patients to make choices and direct them to the most appropriate content for them at a specific time [Walsh et al. 2018a]

Habit

Determinants of technology acceptance; The extent to which people tend to perform behaviors automatically because of learning, also equated with automaticity [Unified Theory of Acceptance and Use of Technology model]

Facilitating conditions

Determinants of technology acceptance; Consumers' perceptions of the resources and support available to perform a behavior [Unified Theory of Acceptance and Use of Technology model]

Hedonic motivation

Determinants of technology acceptance; The fun or pleasure derived from using a technology [Unified Theory of Acceptance and Use of Technology model]

Performance expectancy

Determinants of technology acceptance; The degree to which using a technology will provide benefits to consumers in performing certain activities [Unified Theory of Acceptance and Use of Technology model]

Social influence

Determinants of technology acceptance; The extent to which consumers perceive that important others (e.g., family and friends) believe they should use a particular technology [Unified Theory of Acceptance and Use of Technology model]

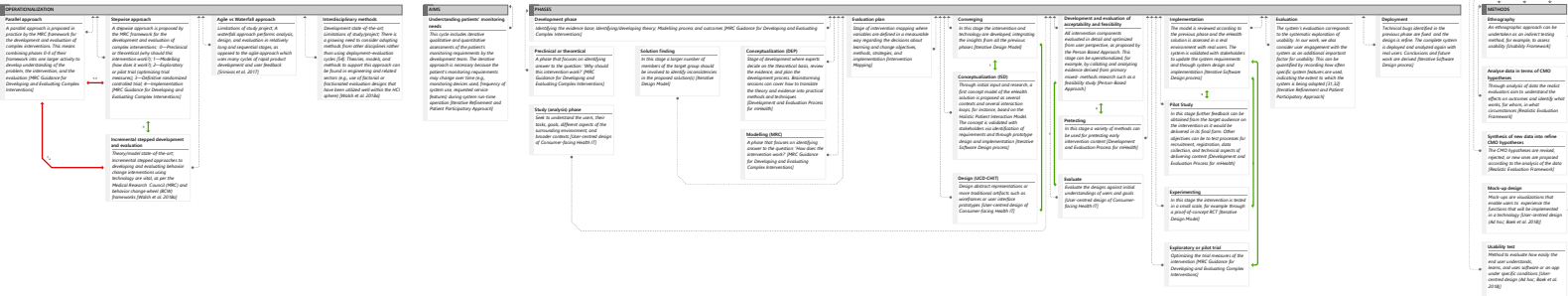
Automatic Motivation

Parameters of effectiveness; Target constructs (sources of behaviors); Automatic processes involving emotional reactions, desires (wants and needs), impulses, inhibitions, drive states and reflex responses [Band et al. 2017; Behavior Change Wheel/COM-B model]

Parameters of effectiveness; Sources of behavior; Motivation describes the brain processes that energize and direct behavior and includes both automatic motivation (e.g., habits) and reflective motivation (e.g., cost-benefit decision making) [Walsh et al. 2018a; Behavior Change Wheel/COM-B model]

eHealth development requires continuous evaluation cycles

Line-of-argument (Conceptual network)



Technology adoption

Line-of-argument (Conceptual network)

OPERATIONALIZATION

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| <p>Diversity of user experiences</p> <p>Development assumption: <i>Heterogeneity (Heart Failure)</i>. Technology acceptance. Accounting for the diversity of user experiences in the development and maintenance of eHealth systems is likely to increase the extent of adoption/uptake and impacts on outcomes for patients and providers. In practice, this highlights the importance of investing time into understanding how different types of users adopt and incorporate digital health technology into their daily lives (Charter et al. 2016)</p> | <p>Tailored, personalized, and timely support</p> <p>Health added value: eHealth state-of-the-art increasingly widespread access to the internet and mobile phones means that eHealth can be accessible to the majority of patients and can be used to provide information and support at any time the patient needs it. eHealth can empower patients by providing better access to personalized information and support for active involvement in treatment and self-management (Bond et al. 2016)</p> | <p>Adaptation to personal routines</p> <p>Mode of delivery and implementation. Development assumption: <i>Heterogeneity (Heart Failure)</i>. The technology must fit visually, naturally and/or be user-friendly into the user's health and mental status, preferences, and recommended medical protocol (Vilijala et al. 2008)</p> | <p>Connection</p> <p>Development assumption: <i>Heterogeneity (Heart Failure)</i>. A key motivator was the sense of connection an eHealth system provides to a support team (e.g., research group), exchanging, for instance, the ability to view daily readings or health information (Charter et al. 2016)</p> | <p>Ask</p> <p>Guidelines for patient-centred care to support active involvement (blended care). Asking the patients how they are getting on, ask if they have any questions or concerns (CARE model)</p> |
| <p>User-centred design process undertaken</p> <p>Techniques (CHO hypothesis) (CAF PM4)</p> | <p>Iterative personalization</p> <p>Development assumption. Evidence gap: Iterative personalization of eHealth services (e.g., remote health monitoring) according to the patient's ongoing healthcare and usability needs is a vital element for successful implementation. Regular adaptation to changing circumstances therefore necessary for widespread and sustained adoption (Tranquillini et al. 2013)</p> | <p>Acceptability and fit of hardware in everyday life</p> <p>Techniques (CHO hypothesis) (CAF PM4)</p> | <p>Adaptive and user-friendly eHealth</p> <p>An adaptive and user-friendly monitoring system can enable a wide range of patients to monitor their health status equitably. This can be achieved through automated calibration of user interactions with the system (by itself and through remote automatic updates without required input from the patients) (Rahimi et al. 2016)</p> | |
| | <p>Personalization and tailoring</p> <p>Development assumption. <i>Heterogeneity (Heart Failure)</i>. Users might be able to use the system with different levels of involvement and understanding, some taking active control (engagement) of their health whereas others appreciate using the system more passively. This could correlate with their level of digital competency (literacy), which makes personalization desirable (Charter et al. 2016)</p> | | | |
| | <p>Tailoring to user's capacity and preferences</p> <p>The need to tailor eHealth (monitoring) systems to user's capacity and preferences should be given sufficient priority during the development stage (Rahimi et al. 2015)</p> | | | |

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| <p>CHALLENGES</p> <p>Overcoming the inertia of mismanagement</p> <p>Development assumption: Design goals should not assume baseline levels of engagement but rather promote it (if even for a relatively short period of time (Services et al. 2017)</p> | <p>Technology knowledge gap</p> <p>Technology acceptance: There exists a gap between younger and older generations when it comes to familiarization with technology (e.g., smartphones). The gap can become an issue during feasibility testing and offset confidence to use a technology over a familiarization process (Duff et al. 2016)</p> |
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| <p>USER INTERACTION PERSPECTIVE</p> <p>User interaction</p> <p>Development aim: Development assumption: User interaction with the technology, both through explicit and implicit input (Vilijala et al. 2008)</p> |
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| <p>SYSTEM USABILITY</p> <p>Easy to learn</p> <p>Dimensions of usability: The easy to learn dimension evaluates how the system supports both initial and long-term use (SE Usability model)</p> | <p>Efficient</p> <p>Dimensions of usability: The efficient dimension refers to how quickly the task can be done (SE Usability model)</p> | <p>Effective</p> <p>Dimensions of usability: The effective dimension explains how completely and accurately a user can complete a task (SE Usability model)</p> | <p>Engaging</p> <p>Dimensions of usability: The engaging dimension highlights how well the interface guides the user relatively through the task (SE Usability model)</p> | <p>Error</p> <p>Dimensions of usability: The error tolerance dimension measures how well a system can avoid user-generated errors and also how the system aids the user in overcoming this error (SE Usability model)</p> |
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| <p>DETERMINANTS & PROCESSES OF TECHNOLOGY ADOPTION</p> <p>Domestication of technology</p> <p>The process of acceptance, rejection and use of technology by its users. Users are seen as social entities and this conceptual model aims to provide a framework for understanding how technology innovation change and are changed by their social context, for instance, according to the Domestication of Technology Theory this process can be divided in four dimensions: appropriation, objectification, incorporation, and conversion (Domestication of Technology Theory)</p> | <p>Appropriation</p> <p>Dimensions of domestication of technology: Dimension that addresses questions such as why users are interested in using the system and what motivates them. This can include an interest to take part in an eHealth related study (Domestication of Technology Theory)</p> | <p>Behavioral intention</p> <p>Determinants of technology acceptance: The intention to use a technology (Unified Theory of Acceptance and Use of Technology model)</p> | <p>Usage intentions</p> <p>Determinants of technology adoption: People's technology use can be predicted reasonably well from their intentions (Technology acceptance model)</p> |
| <p>Objectification</p> <p>Dimensions of domestication of technology: Dimension that is about determining what the eHealth system will be used for by the users (Domestication of Technology Theory)</p> | <p>Performance expectancy</p> <p>Determinants of technology acceptance: The degree to which using a technology will provide benefits to consumers in performing certain activities (Unified Theory of Acceptance and Use of Technology model)</p> | <p>Perceived usefulness</p> <p>Determinants of technology adoption: Perceived usefulness is a major determinant of people's intentions to use technology (Technology acceptance model)</p> | |
| <p>Incorporation</p> <p>Dimensions of domestication of technology: Dimension that is about the practical hand-on use of the eHealth system by users, and how they continue to evaluate its usefulness becomes more or less integral to their daily lives (Domestication of Technology Theory)</p> | <p>Effort expectancy</p> <p>Determinants of technology acceptance: The degree of new secondary abandonment of people's intentions to use computers (Technology acceptance model)</p> | <p>Perceived ease of use</p> <p>Determinants of technology adoption: Perceived ease of use is a significant secondary determinant of people's intentions to use computers (Technology acceptance model)</p> | |
| <p>Conversion</p> <p>Dimensions of domestication of technology: Dimension that deals with the integrated appropriation and continuing interest of users in using an eHealth system (Domestication of Technology Theory)</p> | <p>Experience</p> <p>Determinants of technology acceptance: The passage of time from the initial use of a technology by an individual (Unified Theory of Acceptance and Use of Technology model)</p> | <p>Habit</p> <p>Determinants of technology acceptance: The extent to which people tend to perform behaviors automatically because of learning, also equated with automaticity (Unified Theory of Acceptance and Use of Technology model)</p> | |
| | <p>Facilitating conditions</p> <p>Determinants of technology acceptance: Consumers' perceptions of the resources and support available to perform a behavior (Unified Theory of Acceptance and Use of Technology model)</p> | <p>Historic motivation</p> <p>Determinants of technology acceptance: The fun or pleasure derived from using a technology (Unified Theory of Acceptance and Use of Technology model)</p> | |
| | <p>Social influence</p> <p>Determinants of technology acceptance: The extent to which consumers perceive their important others (e.g., family and friends) believe they should use a particular technology (Unified Theory of Acceptance and Use of Technology model)</p> | | |
| | <p>Price value</p> <p>Determinants of technology acceptance: Consumers' cognitive trade-off between the perceived benefits of the applications and the monetary cost for using them (Unified Theory of Acceptance and Use of Technology model)</p> | | |

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| <p>NORMALIZATION PROCESS COMPONENTS</p> <p>CA: Relational integration</p> <p>Target constructs (Logic model). Developing relationships with HCPs. Building confidence in the system and in relationships with HCPs (Normalization Process Theory)</p> |
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| <p>BUSINESS MODELLING</p> <p>Key partners</p> <p>Key insights for building a minimum viable product: The key partners and their motivations to participate in the business model (Business Model Canvas)</p> | <p>Key activities</p> <p>Key insights for building a minimum viable product: The key activities necessary to implement the business model (Business Model Canvas)</p> | <p>Key resources</p> <p>Key insights for building a minimum viable product: The key resources needed to make the business model possible (Business Model Canvas)</p> | <p>Value propositions</p> <p>Key insights for building a minimum viable product: The value proposition of what is offered to the market (Business Model Canvas)</p> | <p>Customer relationships</p> <p>Key insights for building a minimum viable product: The relationships established with clients (Business Model Canvas)</p> | <p>Channels</p> <p>Key insights for building a minimum viable product: The communication and distribution channels to reach clients and offer them the value proposition (Business Model Canvas)</p> | <p>Customer segments</p> <p>Key insights for building a minimum viable product: The segments of clients that are addressed by the value proposition (Business Model Canvas)</p> | <p>Cost structure</p> <p>Key insights for building a minimum viable product: The cost structure resulting from the business model (Business Model Canvas)</p> | <p>Revenue streams</p> <p>Key insights for building a minimum viable product: The revenue streams generated by the business model (constituting the revenue model) (Business Model Canvas)</p> |
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Health-related outcomes

Line-of-argument (Conceptual network)

OPERATIONALIZATION

Outcomes

Intervention function (Mazur et al. 2017 Behavior Change Wheel) (COM-B model)
 Intervention function: increasing motivating factors to increase capability (Duijven et al. 2018 Behavior Change Wheel)
 Permeation of effectiveness: Intervention function: increasing motivating factors to increase capability (Walters et al. 2016 Behavior Change Wheel) (COM-B model)

Policy categories

Policy categories represent types of actions made by authorities that help to support and sustain an intervention (Behavior Change Wheel) (COM-B model)

Mediation (Intervention function)

Intervention function (Mazur et al. 2017 Behavior Change Wheel) (COM-B model)
 Intervention function: increasing knowledge or understanding (Duijven et al. 2018 Behavior Change Wheel)
 Permeation of effectiveness: Intervention function: increasing knowledge or understanding (Walters et al. 2016 Behavior Change Wheel) (COM-B model)

Environmental Restructuring

Intervention function (Mazur et al. 2017 Behavior Change Wheel) (COM-B model)
 Intervention function: changing the physical or social context (Duijven et al. 2018 Behavior Change Wheel)
 Permeation of effectiveness: Intervention function: changing the physical or social context (Walters et al. 2016 Behavior Change Wheel) (COM-B model)

TECHNOLOGICAL SYSTEM INTERACTIVE

Work processes

Can be physical, cognitive, social, behavioral performance (Systems Engineering Initiative for Patient Safety 2.0)

Health related tasks

Work processes: The action of effort and instruments/time on the part of patients or family members to produce or accomplish something (Systems Engineering Initiative for Patient Safety 2.0)

Patient work

Work processes: Work performed by non-professionals without NCP involvement (Systems Engineering Initiative for Patient Safety 2.0)

Collaborative professional patient work

Work processes: Work involving the active participation of both professionals and nonprofessionals (Systems Engineering Initiative for Patient Safety 2.0)

Outcomes

They are states or conditions resulting from the work process and can be measurable data, observable or undesirable they can refer to patient performance, or organizational outcomes (Systems Engineering Initiative for Patient Safety 2.0)

Presumptive

Outcomes: Presumptive and distal outcomes can be distinguished from other same outcomes may be the immediate result of work processes while others are further down the causal chain and may only emerge over time (Systems Engineering Initiative for Patient Safety 2.0)

Distalities / Indirectness

Outcomes: The outcomes might differ the goals of different stakeholders such as clinicians, organizational leaders, regulatory, policy and patients most importantly, patients (Systems Engineering Initiative for Patient Safety 2.0)

Patient outcomes

Outcomes (Systems Engineering Initiative for Patient Safety 2.0)

CLINICAL GOALS

Clinical Goals

The failure to establish appropriate targets and evaluate treatment to achieve treatment goals (McGlothen et al. 2012)
 Key outcome of HONOR model (COM-B)

Measuring changes in knowledge

Quantifying knowledge (e.g., about self-management) and assessing whether the change observed is either random or the result of measurement error is a challenging, especially with a small sample size. This can be overcome (for example via the BEEM method) (Jordan et al. 2014)

INDICATOR/ OUTCOME

All patients are able to use the system and continue to use it for the duration of the evaluation

Outcomes (CHO hypothesis): This outcome can result from a combination of the efforts literacy of the users (C) and the application of a user centered design process (M) (CHO-PDM)

Continued engagement with system

Outcomes (CHO hypothesis): This outcome can result from the combination of an acceptable system usability from users (C) and a lack of critical problems with the technology (M) (CHO-PDM)

BEHAVIORAL OUTCOMES

Reduction of behavior change

Outcomes of similar rehabilitation (Knowledge, goals, outcome expectations, personal environmental impediments and facilitators) (M) (PDM)

Increased levels of knowledge about self-management

Outcomes (CHO hypothesis): This outcome can result from the combination of the patient's current level of knowledge (C) and the provision of an information and advice website (M) (CHO-PDM)

Self efficacy

Outcomes of similar rehabilitation (M) (PDM)

Self knowledge

Health outcomes (PearlPapp)

Improved self care skills

Health outcomes (PearlPapp)

Self management

Health outcomes (PearlPapp)

Self management related to patient condition

Outcomes (CHO hypothesis): This outcome can result from the combination of the patient's characteristics (C) and the combination of physical and psychological barriers to lifestyle changes (M) (CHO-PDM)

Behavior change that is sustainable over the long term

Outcomes (CHO hypothesis): This outcome can result from the combination of the patient's engagement with a variety of lifestyle changes (C) and the provision of behavioral change techniques such as self-monitoring of symptoms, goal setting according to the user's lifestyle, or feedback on activity performance (M) (CHO-PDM)

Physical activity

Health outcomes (PearlPapp)

Ability to walk further, less weight or management goals

Outcomes (CHO hypothesis): This outcome can result from the combination of the patient's activation (C) and the provision of a walking intervention, e.g., via a mobile device (M) (CHO-PDM)

Balance between activity and rest

Outcomes (CHO hypothesis): This outcome can result from the combination of the user activity/rest cycle of the patient (C) and the provision of feedback on activity (M) (CHO-PDM)

Adherence to medication

Health outcomes (PearlPapp)

INDICATOR/ OUTCOME

Improved symptom control, timely seeking help for health professional treatment

Outcomes (CHO hypothesis): This outcome can result from the combination of the patient's condition stability (C) and the provision of self-monitoring and related feedback (M) (CHO-PDM)

Reduce restrictions

Health outcomes (PearlPapp)

Global health

Health outcomes (PearlPapp)

Quality of life

Health outcomes (PearlPapp)