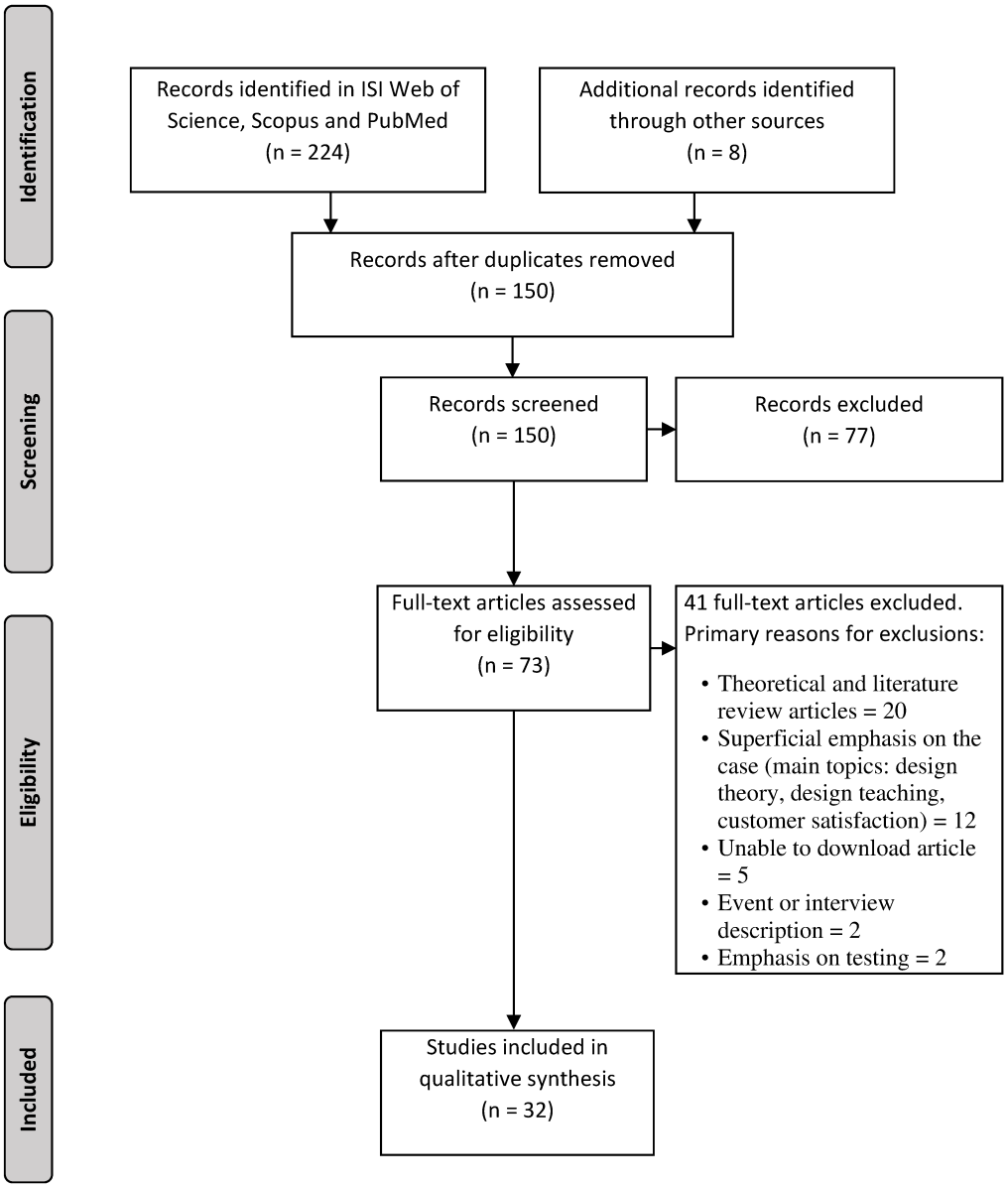
Supplementary files – Exhibit A1: PRISMA Guideline Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3-6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	NA
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	6
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	A3-A4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	NA
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	NA

Supplementary files – Exhibit A1: PRISMA Guideline Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	A2
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	7-13;A3-A4
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	NA
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	NA
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	NA
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	NA
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	NA
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	13-17
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	17
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	17-18
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	18

Supplementary files – Exhibit A2: PRISMA flowchart



Supplementary files – Exhibit A3: Data on study objectives, inclination, contribution, time-frame, funding, disciplines and stakeholders involved

Author, Year	Study objective	Inclination	Main contribution	Study time-frame	Funding	Multidisciplinarity codes	Stakeholders codes
Brennan et al, 2009	Envision how personal health records that promote healthy action can aid nurses in their practices	Design process	Insights about user-centered design focusing both on the patient and the nurse	18 months	Private (Foundation)	Mentions need for multidisciplinarity but do not say which disciplines	Not mentioned
Brennan et al, 2010	Describes a program that promotes the development of a digital platform for using personal health records to aid multiple conditions	Design evaluation	Expanding the concept of personal health records to include observations of daily living and thus enhancing the provision of actionable health information	30 months	Private (Foundation)	Not mentioned	Not mentioned
Brooks et al, 2019	Co-develop and test the feasibility of a culturally-appropriate toolkit to promote mental health literacy and depression/anxiety focused self-management skills in young people, aged 11–15 years, in Java, Indonesia.	Product design	Detailed elaboration of research design	30 months	University-funded	Designers; education professionals; other health professionals	Carers; community; government; management; medical doctors; patients; others
Carroll and Richardson, 2016	Integration of healthcare needs and software requirements, focusing on improving connections between people, enhancing collaboration between stakeholders and establishing better communication	Design requirements	Presents and applies a framework for translating healthcare requirements into software requirements	Not mentioned	Funding agency	Not mentioned	Carers; medical doctors; patients; providers; others
Catalani et al, 2014	Create a clinical decision support system for aiding treatment prescription for HIV patients with tuberculosis	Design process	Detailed process from understanding of the problem to testing phases	12 months (estimated)	Funding agency	IT professionals; medical doctors; researchers	Community; medical doctors; patients
Cheung, 2012	Develop a solution for aiding spine surgery based on an analysis of social trends, economic forces, technological advances and cultural influences for need-finding	Design process	Detailed process for new product development coming from 80 new product opportunity gaps, funneling to 6 clusters of opportunities and combining those into 8 product opportunities	Not mentioned	Not mentioned	Not mentioned	Medical specialists
Coons et al, 2019	Describe the architecture, design, and early testing of a mobile application that facilities the accurate sharing of medication lists among patients, pharmacy and doctors; the application has individual education resources regarding medicines	Design process	Description of design and evaluation of an app from the perspectives of both the community and the hospital	Not mentioned	National institute	Not mentioned	Medical doctors; patients; pharmacists
Cunningham et al, 2016	Performs a baseline study in four African countries to identify features of healthcare practices in rural clinics. Findings will serve as inputs for developing a mHealth solution for maternal and newborn care.	Design requirements	Identification of the state of the practice in healthcare clinics	Not mentioned	Public (European commission)	Not mentioned	Mentions stakeholder involvement as a step for future research
de Ana et al, 2013	Using a case study as a reference, proposes a process for balancing stakeholder voice in the front-end of medical device development	Design process	Creates a process for aligning solutions among multiple stakeholders	8 months	Not mentioned	Designers; management; marketing and business; researchers	Management; marketing, business and sales; medical doctors; patients; providers; researchers; others
Eines and Vatne, 2018	Assess the experiences of a nursing home on applying a design thinking approach to engage staff in innovation activities	Design process and evaluation	Correlation of design practices with organizational layers	Not mentioned	Public	Designers; management; nurses; others	Carers; management; nurses; patients
Greenhalgh et al, 2010	Evaluate the adoption of a personal electronic health record, avoiding the pro-innovation bias and addressing what went wrong in development	Design process and evaluation	Relates the design decisions to the success (or insuccess) of adoption of the innovation	36 months	NHS organizations	Implementation experts; IT professionals	Government; IT professionals; others; the author mentions that patients and physicians were under involved

Supplementary files – Exhibit A3: Data on study objectives, inclination, contribution, time-frame, funding, disciplines and stakeholders involved

Author, Year	Study objective	Inclination	Main contribution	Study time-frame	Funding	Multidisciplinarity codes	Stakeholders codes
Källander et al, 2015	Develop and evaluate approaches for increasing community health workers' supervision, motivation, performance, and retention. Assess the impact of these interventions on coverage of treatment for malaria, pneumonia and diarrhea in children	Design evaluation	Multiplatform approach for community health workers and vulnerable population	18 months	Private (Foundation)	Not mentioned	Mentions stakeholder involvement, but does not mention which stakeholders
Kumar, Uehira and Kay, 2009	Present a solution for improving patient experience in a hospital by providing on-demand directions and guidance	Design process	Detailed description of the design process and design tools employed	Not mentioned	Private (Enterprise)	Not mentioned	Not mentioned
Langell et al, 2019	Design a device for treating cervical cancer in resource-poor regions	Design process	Description of the entire design process, from need identification to market entry	24 months	University-funded	Designers; engineers; marketing and business; medical doctors	Mentions stakeholder involvement, but does not mention which stakeholders
LeRouge et al, 2013	Demonstrate patient involvement in the design and development of a consumer health technology; develop and employ user-profiles and personas as a tool to capture patients' mental model and apply these features to design and development decisions	Product design	Indication on how to effectively understand and model the patients' mental model through a revealing process and artifacts	Not mentioned	Private (Enterprise)	Not mentioned	Carers; management; medical doctors; patients; providers; others
Martin and Barnett, 2012	Drawing from what went wrong in a case of medical device development, establish a way to effectively collect, represent and employ user data in the medical device development process	Design process	Describes each aspect of the design process that contributed to the failure of the user-centered approach in this project	48 months	Private (Enterprise)	Not mentioned	Other healthcare professionals
Martin et al, 2012	Validate and refine the concept of a new device while investigating the process of involving users in early development phases	Design requirements	Demonstration of a rigorous user need validation research	Not mentioned	Public (national funds)	Engineers; medical specialists; nurses	Not mentioned
Mulvale et al, 2019	Apply and assess evidence-based co-design (EBCD) approach on design of three different services for youth with mental health issues	Design process	Method description and replicability	Service 1: 24m Service 2: 8m Service 3: 9m	Public (state and national funds)	Not mentioned	Carers; patients; other healthcare professionals; others
Neinstein et al, 2016	Create a cloud-based, device-agnostic, software platform that could download and integrate raw data from any diabetes device	Software design	Web-based cloud platform	18 months	Private philanthropists and Granting agencies	Designers; entrepreneurs; IT professionals; medical specialists	IT professionals; medical doctors; patients; researchers; others
Pham et al, 2018	Design, develop and assess an analytics platform to analyze data from a mHealth application	Design process	Detailed description of the indicators definition and verification processes	6 months	Not mentioned	Not mentioned	Not mentioned
Ramadas et al, 2015	Improve dietary habits in diabetic patients through a web-based intervention	Design evaluation	Detailed process evaluation of web-based intervention	Not mentioned	University-funded	Medical specialists; nutritionist; researchers; other health professionals	Not mentioned
Ross et al, 2011	Describing the use of a common platform for the development of two applications	Product design	Assessment of challenges in PHR development stages	18 months	Private (Foundation)	Not mentioned	Not mentioned
Rossos et al, 2015	Increase awareness to human factors engineering and user-centered elements of telecare, relating the previous aspects to the successful implementation of telehealth programs	Design evaluation	Correlation of the importance of both people and process in systems implementation	over 10 years	Not mentioned	Not mentioned	Not mentioned
Rudin et al, 2017	Develop a gamified intervention for implementing asthma symptom monitoring via mHealth “from the ground up”, starting with identifying the core components	Design process	Description of detailed requirements, decision points and stakeholder related issues	Not possible to infer full project length	Funding agency	Not mentioned	Medical doctors; patients; providers

Supplementary files – Exhibit A3: Data on study objectives, inclination, contribution, time-frame, funding, disciplines and stakeholders involved

Author, Year	Study objective	Inclination	Main contribution	Study time-frame	Funding	Multidisciplinarity codes	Stakeholders codes
Sammann et al, 2019	Identify needs and priorities from both the users (patients, clinicians, etc) and the system for daily trauma rounds at an academic hospital	Design process	Brings parallel between lean methodology and human-centered design approach; identifies valuable and non-valuable activities and the time spent in each of them during trauma rounds	Not mentioned	Did not receive any funding	Mentions need for multidisciplinarity but do not say which disciplines	Carers; management; medical doctors; nurses; patients; pharmacists; others
Schlosser et al, 2016	Evaluate feasibility, applicability and impact on patient outcomes of a mobile app treatment for schizophrenia on young patients	Design evaluation	Presents the increase in app acceptance after the first refinement iteration from engaging with stakeholders	4 months	Not mentioned	Not mentioned	Carers; patients; providers; researchers
Thaete et al, 2019	Create and evaluate a prototype for measurement of middle-upper arm circumference and determination of corresponding Z score	Design process	Description of the testing stage of a prototype	Not mentioned	Private (Foundation)	Not mentioned	Not mentioned
van der Weegen et al, 2013	Reports the user-centered design process applied for a monitoring and feedback tool to support the self-management of people with chronic disease to obtain an active lifestyle.	Product design	Establishes a process for requirements identification	Not mentioned	Funding agency	Engineers; implementation experts; medical doctors; researchers; others	Patients; other healthcare professionals
Vechakul, Shrimali and Sandhu, 2015	Describe and assess a human-centered approach to mitigate the root causes of health inequity in communities with high poverty rates	Design evaluation	Analysis of the entire design process from design definitions to outcomes	21 months (estimated)	Private (Foundation)	Designers; government and social development initiatives	Mentions community involvement, but does not refer to the term stakeholders
Vilardaga et al, 2018	Describe the rationale, ideation, prototyping, design, user research, and final feature set of a smoke cessation app for people with mental disorders	Design process	Explanation and application of the design process	Not mentioned	National institute	Not mentioned	Medical specialists; patients; others

Supplementary files – Exhibit A4: Data on design thinking tools and solution specification

Author, Year	Inspiration codes	Ideation codes	Implementation codes	Medical specialty	Target condition/ System	Solution modality	Solution objective	Status
Brennan et al, 2009	Not mentioned	Not mentioned	Not mentioned	Chronic disease	Children and teens with complex diseases (congestive heart failure; diabetes; chronic pain; cancer)	E-health (personal health records)	Collect observations of daily living and health monitoring data for clinical guidance	Design finalized
Brennan et al, 2010	Not mentioned	Not mentioned	Not mentioned	Chronic disease	Children and teens with complex diseases (congestive heart failure; diabetes; chronic pain; cancer)	E-health (personal health records)	Collect observations of daily living and health monitoring data for clinical guidance	Functional prototype finalized
Brooks et al, 2019	Focus groups; interviews; review; others	Collaboration groups; data analysis; focus groups	Focus groups; testing; others	Psychiatry	Mental health literacy; anxiety and depression self-management	Toolkit	Promote mental health literacy and depression and anxiety focused self-management skills in young people (11–15yo) in Indonesia	Not started (study protocol established)
Carroll and Richardson, 2016	Data analysis; interviews; observations; shadowing; user definition	Brainstorming; data analysis; feedback; prototype	Feedback; iteration; prototype; testing	Hospitalar management	Pharmacy management	Software	Promote connected health innovation through the improvement of pharmacy management	Design finalized
Catalani et al, 2014	Audio recordings; field notes; interviews; observations; others	Data analysis; prototype	Evaluation; interviews; survey; testing; others	Chronic disease	HIV and tuberculosis	Clinical Support Decision System (m-health)	Guarantee the appropriate treatment for HIV patients with tuberculosis	Implemented
Cheung, 2012	Ethnographic methods; interviews; lists; observations; review	Commercial analysis; conceptualization; field notes; interview; observations; product attributes definition; user empathy; others	Prototype; testing	Surgery	Spine surgery	Device (non-invasive patient tracker)	Minimize patient trauma in spine precise surgery	Functional prototype finalized Clinical feasibility tested
Coons et al, 2019	Need definition; survey	Feedback; sketching; testing	Focus groups; interviews; testing; others	General practice	Medicamentation misusage	E-health (m-health personal health records)	Accurately share medication lists among physicians, patients and pharmacy	Functional prototype finalized
Cunningham et al, 2016	Audio recordings; field notes; focus groups; interviews; need definition; review; user definition; user empathy; others	Not mentioned	Not mentioned	Family health	Maternal and newborn overall health	E-health (m-health)	Improve the quality of maternal and newborn healthcare delivery in rural clinics in Africa	Need assessment finalized
de Ana et al, 2013	Ethnographic methods; focus groups; interviews; need definition; observations; shadowing; surveys; user empathy; others	Brainstorming; focus groups; interview; prototype; user empathy; others	Conceptualization; interviews; marketing and commercial strategies; survey	Orthopedics	Fracture repair	FDA class III therapeutic device self-administrated at home	Enhance/accelerate fracture repair	Design finalized
Eines and Vatne, 2018	Observations; user empathy; workshops	Brainstorming; conceptualization	Testing	Hospitalar management	Meeting patients demands for service quality, economic sustainability and skilled health care professionals	Customized timetable	Determine roles and responsibilities for nursing team aligned with their personal abilities and nursing home needs	Implemented

Supplementary files – Exhibit A4: Data on design thinking tools and solution specification

Author, Year	Inspiration codes	Ideation codes	Implementation codes	Medical specialty	Target condition/ System	Solution modality	Solution objective	Status
Greenhalgh et al, 2010	Not mentioned	Not mentioned	Ethnographic methods; field notes; interviews; observations; shadowing; others	Chronic disease	Patient monitoring	E-health (personal health records)	Mitigate lack of integration across the NHS avoiding fragmentation of care, inefficiency, and risk	Implemented and failed
Källander et al, 2015	Consultations; lists; review	Not mentioned	Not mentioned	Pediatric	Children with diarrhea, pneumonia and malaria	Training of community health workers employing m-health	Improve health outcomes as result of increasing community health worker performance and motivation	Implemented Ongoing cluster randomized controlled trial
Kumar, Uehira and Kay, 2009	Interviews; workshops; others	Data analysis; data summarizing; interview; observations; user empathy	Prototype	Hospitalar management	Patient experience in a hospital	Direction and guidance system	Help patients that tend to get lost in the hospital	Functional prototype finalized Ongoing testing
Langell et al, 2019	Need definition; review; shadowing; user empathy; others	Data analysis; prototype; others	Interviews; iteration; marketing and commercial strategies; testing; others	Oncology	Cervical cancer	Thermal coagulation device	Allows for the treatment of precancerous cervical lesions at low cost	Implemented Commercialization
LeRouge et al, 2013	Audio recordings; focus groups; interviews; observations; review; others	Data analysis; user empathy	Not mentioned	Geriatrics	Diabetes	E-health (personal health records)	Improve self-monitoring of diet and exercise for elderly diabetics	Need assessment finalized
Martin and Barnett, 2012	Interviews; user definition	Data analysis	Ethnographic methods; shadowing; others	Radiology	Medical imaging	Imaging device	Provide an inexpensive, portable imaging device	Functional prototype finalized Route for commercialization being considered
Martin et al, 2012	Brainstorming; field notes; interviews; others; user definition	Brainstorming; data analysis; data summarizing	Not mentioned	Radiology	Medical imaging with an emphasis on phlebotomy applications	Imaging device	Provide an inexpensive, portable medical imaging device	Need assessment finalized
Mulvale et al, 2019	Audio recordings; focus groups; interviews; others; user empathy	Brainstorming; conceptualization; data analysis; prototype; others	Prototype	Psychiatry	Depression Anxiety Eating disorders Psychotic disorders	Not mentioned	Improving coordination of mental health care for youth, related supports, and transitions to adult care; improving employment supports for youth with mental health	Visual prototype finalized
Neinstein et al, 2016	Interviews	Not mentioned	Prototype; feedback	Chronic disease	Diabetes (Type 1)	E-health (m-health)	Create a cloud-based platform to integrate data from devices used to monitor diabetes	Functional prototype finalized Ongoing testing
Pham et al, 2018	Focus groups; review	Not mentioned	Evaluation; field notes; iteration; observations	Chronic disease	Chronic pain	E-health (m-health)	Pain self-management for youth and young adults from 12 to 25	Functional prototype finalized Full development hired

Supplementary files – Exhibit A4: Data on design thinking tools and solution specification

Author, Year	Inspiration codes	Ideation codes	Implementation codes	Medical specialty	Target condition/ System	Solution modality	Solution objective	Status
Ramadas et al, 2015	Prototype	Feedback; prototype	Testing	Chronic disease	Diabetes (Type 2)	Web-based education program	Improve population's dietary habits	Functional prototype finalized
Ross et al, 2011	Consultations; focus groups; interviews	Conceptualization; feedback; focus groups; prototype	Testing; others	Pediatrics and Geriatrics	Patients taking multiple medications	E-health (personal health records)	Manage drug self-administration to avoid adverse events	Functional prototype finalized (needs to meet data safety standards for release)
Rossos et al, 2015	Not mentioned	Not mentioned	Not mentioned	Gastroenterology	Bariatric surgery	E-health (remote telemedicine consultations)	Improve treatment follow up for people living far from the hospital	Implemented Over 300 consultations executed in the first 18 months
Rudin et al, 2017	Consultations; interviews; others	Conceptualization; feedback; prototype; user empathy	Conceptualization; prototype; testing; others	Chronic disease	Asthma	E-health (m-health)	Asthma monitoring in a way that data can be used by patients, physicians and EHR	Functional prototype finalized Tests finalized
Sammann et al, 2019	Interviews; observations	Not mentioned	Not mentioned	Hospitalar management	Trauma surgical rounds	Not mentioned	Improve efficiency on trauma rounds	Need assessment finalized
Schlosser et al, 2016	Interviews; workshops	Prototype; others	Not mentioned	Psychiatry	Youth with schizophrenia	E-health (m-health)	Improve motivated behavior in the early phases of the illness on young patients	Functional prototype finalized random control trials ongoing
Thaete et al, 2019	Not mentioned	Not mentioned	Evaluation; feedback; testing	Pediatric	Child nutritional status diagnosis	Analogical device (measurement ruler)	Provide both measurements of upper arm circumference and determination of corresponding Z score in a single step	Functional prototype finalized and tested Patent filed Next-generation of the prototype is redesigned
van der Weegen et al, 2013	Review	Collaboration groups; interviews; others	Not mentioned	Chronic disease	Chronic obstructive pulmonary disease or type 2 diabetes	E-health (m-health personal health records)	Stimulate physical activity in patients with chronic disease	Design finalized
Vechakul, Shrimali and Sandhu, 2015	Data analysis; observations; others	Brainstorming; conceptualization; data summarizing; prototype	Marketing and commercial strategies; prototype; testing	Pediatric	Infant mortality rate	Event	Addressing the roots of health inequities in infants mortality rate in poor communities	Implemented Served as an incentive for new initiatives
Vilardaga et al, 2018	Field notes; focus groups	Prototype; sketching; user empathy	Evaluation; interviews; prototype; testing	Addiction	Smoke addiction	E-health (m-health)	Engage smokers with mental health issues to quit smoking	Functional prototype finalized

Supplementary files – Exhibit A4: Data on design thinking tools and solution specification

Author, Year	Inspiration codes	Ideation codes	Implementation codes	Medical specialty	Target condition/ System	Solution modality	Solution objective	Status
Wilson et al, 2012	Ethnographic methods; focus groups; interviews; observations; surveys	Others	Survey	Geriatrics	Elderly care	E-health (hardware with supporting network and recording/monitoring software; a suite of telemedicine and telemonitoring devices; and an associated set of tele-accompany services)	Ease the life of older people in their home	Interrupted due to resource limitations
Woods et al, 2018	Brainstorming; field notes; user empathy; others	Conceptualization; data analysis; feedback; sketching	Feedback	Chronic disease	Heart failure	E-health (m-health)	Self-management of heart failure	Final product developed

Supplementary files – Exhibit A5: Codification of Design Thinking tools (references numbers according to the main document)

Inspiration tools codes	Inspiration tools as mentioned by authors
Audio recordings	audio recordings [50]; audio records [28]; audio-records [31]; recording [29]
Brainstorming	brainstorm [3]; brainstorming [27]
Consultations	consultations [51]; patient consultation [40]; visits [43]
Data analysis	data analysis [34]; synthesize insights [53]
Ethnographic methods	ethnography [56]; ethnographic methods [45]; ethnographic research [33]
Field notes	field notes [3,27,28,36,50]
Focus groups	expert panel [36]; focus groups [28–31,43,56]; group need assessment session [46]; panel of payers [33]; physician panels [33]
Interviews	Interview [31,33,38]; interviews [29,43,47,48,56]; key informant interview [50]; recorded interview [27]; semi-structured interviews [27,28,30,34,39,40]; telephone interviews [33]; unstructured interviews [26]; user interviews [45]
Lists	list of categories for opportunities [45]; list of product opportunity gaps [45]; list of social trends, economic forces, technological advances and cultural influences (SETC factors) [45]; list of potential innovations [51]
Need definition	core requirements identification [42]; draft of user needs [54]; uncovered pain points [33]; usability and user experience requirements [28]; validation of the clinical problem [54]
Not mentioned	not mentioned [35,41,44,52,55]
Observations	field observations [45]; field research observations [33]; in-context observations [26]; observation [29]; observation studies [34]; observations [49,56]; observe and inspire [53]; site observation sessions [50]
Others	clinical practice guidelines search [32]; definition of data elements to be captured [28]; feedback [54]; individual design sessions [40]; keyword collection [47]; photo-elicitation method [30]; photographs [3]; simulation testing [50]; specification of research objectives [27]; tell stories [53]; transcription [29,31]; trigger videos [31]; videotaping [33]; workflow and reporting requirements [28]
Prototypes	paper prototype
Review (literature, historical, best practices)	background research [54]; historical background review [51]; information about working practices [28]; literature research [32]; literature review [30,51]; review of previous documentation [29]; review of the therapeutic landscape [54]; scoping review [46]; task analysis [45]
Shadowing	procedural shadowing [54]; shadow [34]; shadowing [33]
Surveys	survey [56]; survey with potential users [42]; surveys [33]
User definition	analysis of end user profiles [28]; definition of a standard user [34]; user definition [27,39]
User empathy	clinical immersion [54]; concept preference testing [33]; environment examination [28]; experience maps [31]; individual summaries [3]; persona [3]; walkarounds [49]
Workshops	workshop [49]; workshops [47,48]

Supplementary files – Exhibit A5: Codification of Design Thinking tools (references numbers according to the main document)

Ideation tools codes	Ideation tools as mentioned by the authors
Prototype	digital prototype [54]; low fidelity mockups [40]; low fidelity models [33]; moch prototype website [37]; paper mockups [48]; paper prototyping [36]; physical device prototype [54]; pilot [43]; prototype [50,53]; prototyping [34,48]; rapid prototyping [33]; visual prototype [46]
Not mentioned	not applied [26,46]; not mentioned [28,35,38,41,44,51,52,55]
Data analysis	data analysis [3,27,29–31,34,39,47,50,54]; data translation [50]; verbalization analysis [27]
Others	audio recordings [45]; coding analysis [45]; computer screen captures [45]; data collection tools [33]; field notes [45]; photographs [45]; poker chip sort [33]; problem definition [31]; radiographic films [45]; simulations [48]; treatment modality selection [54]; user testing [42]; visualization tools [56]
Conceptualization	concept development [49]; create concepts [53]; holistic product definition [45]; individual design sessions [40]; storyboard [3,43]; theme clustering across participants [31]; wireframe [3]
User empathy	"before, during, after" experience tool [47]; experience maps [33]; persona tool [45,47]; personas [36]; scenario-based drama [29]; user persona [29]; user profile [29]; workflow diagrams [40]
Feedback	feedback [3,40,42,43]; feedback from experts [37]; prototype, test, and feedback from stakeholders [34]
Brainstorming	brainstorm [53]; brainstorming [27,33,34,49]; individual brainstorm [31]
Interview	audio-recorded interviews [45]; focus groups interviews [32]; in-depth interviews [47]; interviews [32,33]
Sketching	concept design [42]; sketches [3]; sketching [36]
Data summarizing	data synthesis [47]; executive summary [27]; main report summarizing data [27]; synthesize insights [53]
Focus groups	design workshops [30]; final review events [30]; focus groups [43]; panel discussions [33]
Observations	field observations [45]; observation research [47]
Collaboration groups	collaboration group [30]; expert meetings [32]; sustained group works [30]
Commercial analysis	stakeholder analysis [45]; value opportunity analysis (VOA) [45]
Product attributes definition	devised scenario [45]; product attributes [45]; weighted matrix [45]

Supplementary files – Exhibit A5: Codification of Design Thinking tools (references numbers according to the main document)

Implementation tools codes	Implementation tools as mentioned by the authors
Testing	beta test with patients [37]; identification of all variables tested in each prototype [34]; iterative testing [43]; multisite testing [30]; template for intervention description and replication [30]; test [49]; test and refine [53]; testing [36,44,49]; testing session [42]; usability testing [50]; user testing [40]; user validation testing [54]; validation with consulting surgeon [45]
Not mentioned	not applied[26,27]; not mentioned [28,29,32,35,41,48,51,52]
Others	audio recordings [50]; audiotapes [55]; data analysis [55]; evidence-based framework [30]; expert consultation [40]; heuristics analysis [40]; implementation [50]; informative flyer [42]; photos [39]; review of regulatory classification requirements [54]; socio-technical networks [55]; video records [43]
Prototype	creation of service and product ideas and prototypes [47]; functional prototype [45]; high fidelity prototype [40]; prototype [31,47,53]; prototyping [38]; software prototyping [36]; rapid prototyping [34]
Interviews	in depth interviews [50]; interview [33,36,54]; interviews [55]; semistrutured interviews [42]
Feedback	feedback [3,34,38,44]
Evaluation	evaluation [50]; measurement [50]; questionnaires [44]; rating [36]; usability and accessibility evaluation [46]
Iteration	iteration [34,43,46,54]
Survey	evaluation through surveys [56]; survey [50]; web survey [33]
Marketing and commercial strategies	business plan [54]; market penetration strategy [54]; marketing quantitative study [33]; “scale, spread and sustain” [53]
Shadowing	shadowing [39,55]
Observations	observation [55]; on-site observation [46]
Field notes	field notes [46,55]
Conceptualization	individual design sessions [40]; multiple concept creation [33]
Ethnographic methods	ethnographic methods [55]; ethnography [39]
Focus groups	focus group [42]; stakeholder consultation events [30]