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The successes and lessons of a Dutch University Hospitals' eHealth program: An evaluation study protocol

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ABSTRACT

Background: University Hospitals (UHs) are key players in contributing to a sustainable health care system. In the Netherlands the eight UHs joined forces from 2016 till 2018 within the *Citrien fund (CF) – program eHealth* to develop sustainable eHealth solutions by carrying out 32 research projects.
Objective: The objective of this study was to develop an evaluation study protocol that would be capable of evaluating the first Dutch University Hospitals eHealth program in depth.
Methods: To develop the protocol three consecutive steps were carried out: 1) a rapid review to find suitable eHealth evaluation frameworks and eHealth project progress indicators, 2) assessment of the selected eHealth evaluation frameworks to determine the most suitable framework to evaluate *CF - program eHealth,* and 3) development of a mixed-methods study to evaluate eHealth project progress indicators in relation to the 32 eHealth research projects.
Results: The 'Commonwealth Scientific and Industrial Research Organization (CSIRO) framework for evaluating telehealth trials or programs' was deemed most suitable for evaluating *CF - program eHealth*. The aspects planning, needs assessment, policy/organization, technology, ethics, legal, and finance, were considered useful indicators for monitoring the progress of an eHealth project, and therefore incorporated into the survey.
Conclusion: The developed evaluation study protocol will be used to evaluate the first Dutch University Hospitals' eHealth program, the *CF – program eHealth*, and therewith contribute to maximizing successful uptake of eHealth solutions. Also, the selected set of eHealth project performance indicators could be used by researchers or policymakers to securely monitor the progress of eHealth projects.

Introduction

Global aging, with rising life expectancy as its driving force, is a relatively new worldwide phenomenon. In some fast-aging European countries, the percentage of elderly could even reach 35% of its respective populations by 2050.[1] Unavoidable consequences include an increase of health care expenditures and a potential shortage of health care professionals. Therefore, governments are increasingly looking for sustainable, innovative solutions to limit health care costs and to keep the health care system accessible for all who are in need. It is estimated that 'eHealth', also often referred to as 'telemedicine' or 'telehealth', may contribute significantly to those sustainable, innovative solutions.

In this article, we used Eysenbach's definition (Box 1) of 'eHealth' in 2001, which is also used in the development of the

Abbreviations: CF, citrien fund; CHEATS, Clinical, Human and organizational, Educational, Administrative, Technical, Social evaluation framework; CSIRO, Commonwealth Scientific and Industrial Research Organization; UHs, Univeristy Hospitals; NFU, The Netherlands Federation of UHs (in Dutch: Nederlandse Federatie van Universitair Medische Centra); WHO, World Health Organization.

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CONSORT-EHEALTH (Consolidated Standards of Reporting Trials of Electronic and Mobile HEalth Applications and onLine TeleHealth) guideline.[2,3]

Box 1 eHealth definition by Eysenbach – 2001. eHealth is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.

Nowadays the terms 'telemedicine', 'telehealth', and 'eHealth' are increasingly used interchangeably and there also seems to be a geographical preference. Authors from European countries use the term 'eHealth' more often than authors from the United States, where the term 'telemedicine' is more frequently used. Based on the trends in number of publications from the last ten years, it is predicted that more documents will refer to the term 'eHealth' than to the term 'telemedicine' by the year 2022.[4] Although the rapid growth in number of publications might be due to an increasingly request for compelling evidence of the effectiveness and safe-use of eHealth, implementing eHealth solutions after a pilot study or scaling up to a larger audience seems challenging.[5] Therefore, a thorough scientific evaluation evaluating the multiple aspects of a novel eHealth solution is of utmost importance.

eHealth evaluation research

Primarily, evaluation research can be subdivided into a summative (or outcome) and formative type.[6] In health care research, most evaluations are summative, describing quantitative outcomes such as clinical effectiveness, safety, and costs.[7] However, a formative evaluation postulates a wider view on how the quantitative outcomes were achieved, mostly by applying qualitative techniques.[8] A formative evaluation may yield useful information about organizational aspects, social interactions, and contribute to more adaptable and scalable interventions.[9]

In eHealth evaluation research, the majority of the published studies performed a summative evaluation. Most frequently the 'gold standard' Randomized Controlled Trial (RCT) was performed.[10–13] However, in order to improve the quality of eHealth evaluation, and therewith facilitate long-term implementation, evaluation should not be limited to just health outcomes or cost-benefits. It should cover a wider range of themes, such as information about the developmental process or usability of an intervention.[9,11,14,15]

Lee et al. demonstrated the advantages of conducting a formative evaluation early in the developmental process.[16] Through a strategic planned set of formative evaluation approaches, such as contextual understanding, participatory design and feasibility studies, they successfully developed an eHealth solution enabling home-based monitoring of disease progression and treatment outcome for patients with rheumatoid arthritis. Unfortunately, case examples such as the one from Lee et al. are scarce and conducting a formative evaluation in addition to a summative evaluation is little done. Therefore, by conducting a thorough evaluation of a Dutch University Hospitals' eHealth program, we aim to contribute to insights in and practice of formative evaluation of eHealth. Moreover, we want to set an example for other eHealth evaluators evaluating comprehensive eHealth programs and therewith enhance successful implementation and upscaling of eHealth in general.

A first joint Dutch University Hospitals' eHealth program

In the Netherlands, the University Hospitals (UHs) are seen as key players in providing excellent patient care, leading medical research, educating future health care professionals, and having solid social networks and well-functioning infrastructure. To support the UHs the Dutch government founded the *'Citrien fund' (CF)* for the period of 2014 – 2018. Five different program themes aimed to contribute to sustainable, innovative solutions in order to handle one of the challenges in health care of this moment: 'How can quality of care be improved and how can we ensure affordable care in the future?' In this present paper, we focused on the development of a protocol to evaluate the program theme 'eHealth'. The objective of the *CF - program eHealth* was to accomplish 11 predefined program outcome deliverables by the end of 2018 (Box 2). To achieve this, the eight Dutch UHs each carried out tree till four evidence-based eHealth projects from June 2016 until December 2018. The projects either developed a tangible eHealth solution or delivered knowledge about the use and/or development of an eHealth solution, and covered a wide variety of eHealth subjects to optimally ensure the program deliverables were addressed.

Box 2 Deliverables of the *CF - program eHealth*.

1. One coordinating NFU vision on eHealth and NFU eHealth road map
2. A virtual nationwide expertise center for eHealth
3. (Inter)national positioning by promoting in journals, media and during closure event
4. Conditions for downloading medical data described and if possible realized
5. Blueprint for interoperability between hospital information systems and EHRs
6. Agreements and standards for data sharing between consumer and professional eHealth
7. A framework for regional collaboration in favor of effective implementation of eHealth
8. Models that can strengthen the empowerment of the patient
9. A developed multidisciplinary infrastructure to stimulate development of digital health
10. Development, evaluation and implementation of eHealth instruments in collaboration with companies and start-ups
11. Development of an educational blueprint with focus on eHealth competences and skills of health care professional

The objective of this paper was to develop an evaluation study protocol, with a focus on the formative part of eHealth evaluation, that would be capable of evaluating the first joint Dutch University's eHealth program in depth and that could serve as an example for other comprehensive eHealth programs. The development of the protocol followed a three-step methodology:

1. Rapid literature review – to find existing eHealth evaluation frameworks and select project progress indicators of eHealth projects in general,
2. Qualitative assessment of a selection eHealth evaluation frameworks – to determine the most suitable framework to evaluate the successes and lessons *of CF – program eHealth,*
3. The development of a mixed-methods study to evaluate eHealth project progress indicators in relation to the eHealth projects of the *CF – program eHealth.*

Evaluation study development

Step 1: Rapid literature review

Method

A 'rapid review' is a review of peer-reviewed literature that answers a research question efficiently, competently, and satisfactorily within a short time frame.[17,18] A rapid review mimics a systematic review but searches fewer databases, uses a quicker screening method, and narrower criterion for inclusion of studies can be applied in order to draw conclusions on a short-term base about a specific research topic. The main objective of Step 1 was not to carry out a classic systematic literature review, but to gather information on methods that are capable of evaluating the *CF - program eHealth* and to select eHealth project progress indicators that could be monitored to determine the progress of an eHealth project. Therefore, we decided that a rapid review of peer-reviewed literature would be sufficient. We estimated that one search could fulfil both aims, mostly because papers on evaluation methods, models, or frameworks compromise eHealth project progress indicators as well. When the information about the indicators was insufficient, a second search was carried out.

The search engine PubMed was searched with the terms *"Telemedicine"[Mesh] AND "Program Evaluation"[Mesh]* for English language articles published between January 1995 and September 14, 2018. The MeSH 'Telemedicine' includes the key terms 'eHealth' and 'telehealth'. Articles were screened on title and abstract, and included for full-text assessment if they concerned eHealth evaluation. All types of study designs were included, except for articles describing an clinical trial such as an RCT, conference posters or abstracts. Disease specific articles with an eHealth solution as intervention were excluded. During the full-text assessment the articles were reviewed more in depth, and frameworks, models or other methodologies capable of evaluating an eHealth program were extracted and included into the general selection of the rapid review. From the general selection, eHealth evaluation frameworks that were capable of evaluating a comprehensive eHealth program with multiple and various projects, such as the *CF – program eHealth*, were selected and subjected to a applicability assessment in Step 2 of this paper.

Results

In total, 690 articles were retrieved from PubMed. After screening title and abstract, 46 articles were reviewed in full-text for eligibility. Finally, a total of 19 articles were included (Fig. 1). To systematically order the information from the 19 articles, two overview tables were created.

Appendix A. presents an overview of all the frameworks reported in the included articles. In this overview the following frameworks are marked with an asterisk: Telehealth Integrated Research Model (TRIM); Clinical, Human and organizational, Educational, Administrative, Technical, Social (CHEATS); Model for Assessment of Telemedicine (MAST); Commonwealth Scientific and Industrial Research Organization (CSIRO); Reach, efficacy, adoption, implementation and maintenance (RE-AIM); and Consolidated framework for implementation research (CFIR). These frameworks were selected because they were esteemed to have the best fit for evaluating *CF - program eHealth* and were therefore subjected to the qualitative assessment in Step 2.

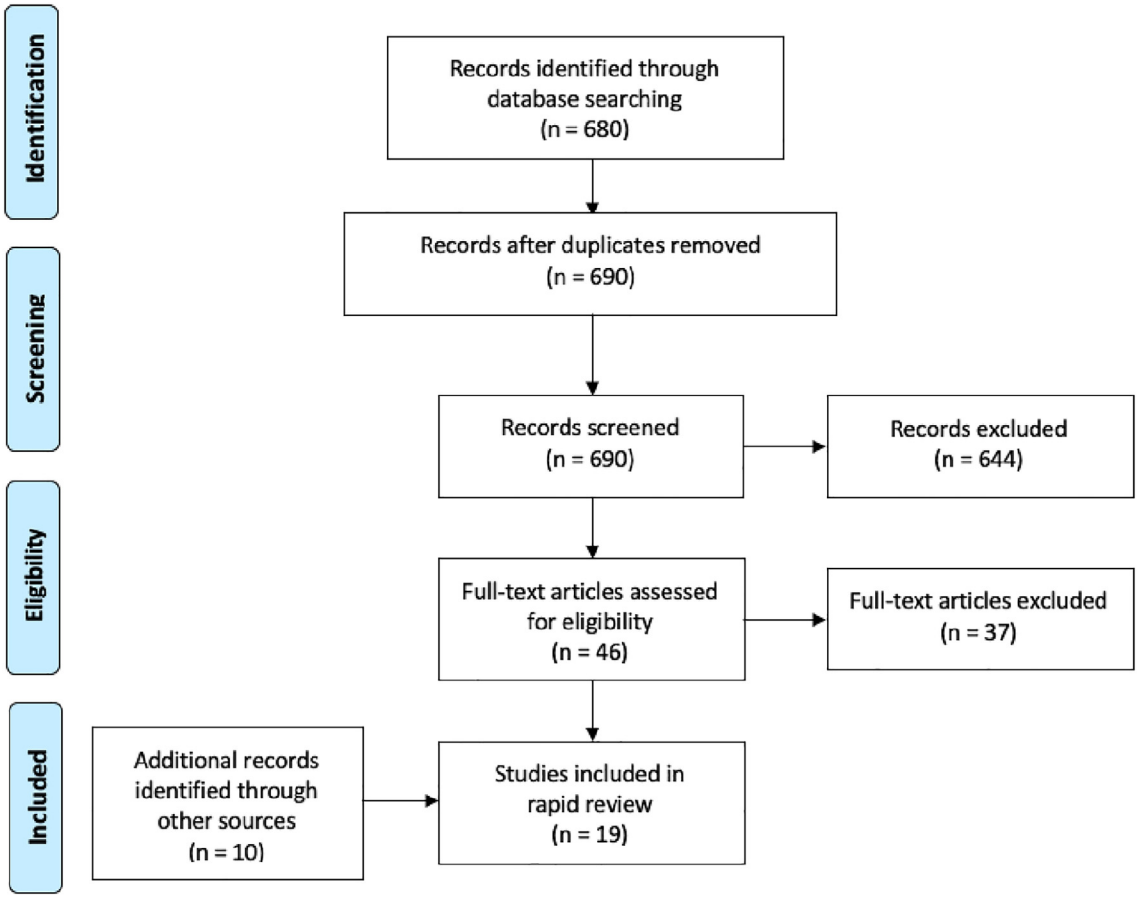

Fig. 1. PRISMA flow chart of rapid review.

Fig. 2. eHealth project progress monitoring aspects.

Appendix B. presents the eHealth project progress indicators that were found in the results of the rapid review as well. The following indicators were determined. An eHealth project should start with a solid plan and definition of the needs of the end-user, for example, through a needs assessment. Although the preferences of an end-user should be leading in the development process, because he or she has to use the eHealth solution, it must fit into local eHealth policies and organizations as well. There must be readiness for change in reorganizing the health care system. Technological, ethical, legal, and financial aspects are important aspects that influence the success of the development, implementation and sustainability of a project. In conclusion, the aspects planning, needs assessment, policy/organization, technology, ethics, legal, and finance (Fig. 2) were considered useful indicators for monitoring the progress of an eHealth project during the development and implementation phases.

Step 2: Qualitative assessment of selected eHealth evaluation frameworks

Method

The aim of Step 2 was to determine which one of the selected eHealth evaluation frameworks in Step 1 was most suitable for the evaluation of the *CF - program eHealth*. It should be possible to apply this framework or aspects of the framework on future UHs eHealth programs as well. The extent to which the eHealth

Table 1
Applicability assessment of the six selected evaluation methods.

Method	Author (year)	Short summary	Evaluation domains	Applicability criteria[#]		
				Solution	Knowledge	Outcomes
1. RE-AIM[1]	Glasgow (1999)	The RE-AIM evaluation model emphasizes the reach and Representation of both participants and settings. It conceptualizes the public health impact of an intervention as a function of five factors.	reach, efficacy, adoption, implementation and maintenance.	+/−	±	−
2. TIRM[2]	Scott (1999)	TIRM emphasizes the need that evaluation be an integral part of any telehealth program design (context); execution (implementation); and review (reassessment), to inform other initiatives.	Context; implementation; and reassessment	−	±	−
3. CHEATS[3]	Shaw (1998–2000)	CHEATS methodology is a comprehensive framework from which aspects can be drawn and partly utilized. Both qualitative and quantitative research methods are used.	Clinical, Human and organizational, Educational, Administrative, Technical, Social	±	±	+/−
4. CFIR[4]	Damschroder (2009)	The CFIR offers an overarching typology, a list of constructs to promote theory development and verification about what works where and why across multiple contexts. Researchers can select constructs from the CFIR that are most relevant for their particular study setting and use these to guide diagnostic assessments of implementation context, evaluate implementation progress, and help explain findings in research studies or quality improvement initiatives.	Intervention characteristics, Outer setting, Inner setting, characteristics of the individuals involved, process implementation	+/−	±	−
5. MAST	Kidholm (2012)	MAST provides a structure for future assessment of telemedicine applications, adapted to the users' and stakeholders' need for information in decision making.	Preceding considerations, Multidisciplinary assessment, transferability	+/−	±	−
6. CSIRO	Nepal (2014)	The CSIRO telehealth evaluation framework consists of six major components and the key characteristics of the framework are: 1) loosely coupled and hence easy to use, 2) provides a basis for describing a wide range of telehealth programs, and 3) extensible to future developments and needs.	Health domains, health services, technologies, communication infrastructure, environment setting, and socioeconomic evaluation	±	±	+/−

#The applicability criterion 'solution' describes if the method can map a project that delivers a tangible eHealth solution, 'knowledge' describes if the method is capable of mapping a project that solely delivers knowledge, and 'outcomes' describes if the method could be used to evaluate various outcomes of a single project. +: The method is able to map the project of or evaluate outcomes. +/−: The method is partially able to map the project or evaluate outcomes. −: The method is not able to map nor to evaluate outcomes.
[1]Reach, efficacy, adoption, implementation and maintenance; [2]Telehealth Integrated Research Model; [3]Clinical, Human and organizational, Educational, Administrative, Technical, Social; [4]Consolidated framework for implementation research; [5]Model for Assessment of Telemedicine; [6]Commonwealth Scientific and Industrial Research Organization.

projects contribute to the deliverables (Box 2) was considered an important aspect of the success of the *CF - program eHealth*. To investigate this aspect, we reasoned that the evaluation framework should be able to map the contribution of each individual project to their related program deliverable(s). Besides mapping the achievement of the deliverables, the framework must be capable to evaluate the outcomes of projects of the *CF - program eHealth* in a systematic way. As described in the introduction, the projects either delivered a tangible eHealth solution or provided knowledge about the use and/or development of an eHealth solution. Therefore, the evaluation method should be able to map and evaluate both types of projects.

To determine the applicability of the six evaluation methods selected in Step 1, the methods were subjected to an applicability assessment consisting of a critical assessment of three applicability criteria (Table 1). The first two criteria evaluated whether the method would be able to evaluate the 'solution' and 'knowledge' project types. The 'solution' and 'knowledge' column fields received a '+' if the method can map the particular project type, a '+/−' if the method is able to partially map the project, or a '-' if the method is unable to map the project type. The third criterion, 'outcomes', received a '+' if the method could be used to evaluate outcomes of a single project, for example, effectiveness and costs. If the method received a '+/−' the method is partially able to evaluate outcomes, and if it received '-' it is unable to evaluate outcomes of a project. The evaluation methods with the best scores were described in more detail, compared and thereafter the most suitable method to evaluate *CF – program eHealth* was selected. If necessary, the selected method was adapted. To check whether the method was indeed capable of mapping the projects of the *CF – program eHealth*, the details of two randomly-selected projects of the *CF – program eHealth* were filled out. Mapping of all the projects of the *CF – program eHealth,* will be done when carrying out the study protocol in the final evaluation study.

Results

As presented in Table 1, The Clinical, Human and organizational, Educational, Administrative, Technical, Social (CHEATS) evaluation framework and Commonwealth Scientific and Industrial Research Organization (CSIRO) framework for evaluating telehealth trials or programs, had the best scores on the three applicability criteria.

CHEATS was developed by Nicola Shaw and is a generic information and communication technology (ICT) evaluation framework based on formative process evaluation and utilizes both quantitative and qualitative methods.[19] The six domains of CHEATS each have multiple aspects that can be used to evaluate an eHealth project. The author states that it is unlikely that any ICT evaluation would utilize the full CHEATS framework, but it does provide a strategy that can be partly drawn upon and utilized. As for the *CF - program eHealth* projects, we expected that both the 'solution' and 'knowledge' project types can be evaluated with the CHEATS framework and that the six evaluation domains can enhance qualitative insights about the project outcomes.

The CSIRO framework was developed by the Commonwealth Scientific and Industrial Research Organization with the aim to design a comprehensive telehealth framework that explicitly introduces the socioeconomic aspect to the evaluation of telehealth (Fig. 3).[20] In the middle of the framework one can find: 'health domain', such as paediatrics, dermatology, and neurology; second 'health services' domain which generally includes the clinical options such as: triage, diagnostic, treatment, consultation, monitoring, and case review and the non-clinical options such as education, training, supervision, administration, and research; and third 'telehealth technologies' which describes the possible communication and interaction technologies that are used. 'Communication technologies' is used to describe what kind of broadband network

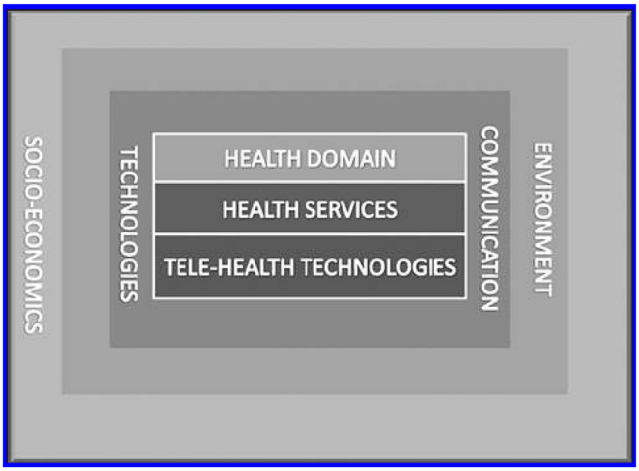

Fig. 3. Commonwealth Scientific and Industrial Research Organization framework of evaluating telehealth trials or programs (Source: Nepal et al., 2014, pg396).

is used and the 'environment setting' captures the health service context described in the four elements: people, locations, communication mode, devices. The last layer that cuts across all the five previously-mentioned components of the CSIRO framework is the socioeconomic evaluation. This layer analyses the costs, benefits, barriers, and clinical outcomes and is therefore important in measuring the feasibility and success of the eHealth project.

The main difference between the CHEATS and CSIRO framework, was the lack of a socioeconomic evaluation aspect in the CHEATS framework. As for the evaluation of an UHs eHealth program, the socioeconomic evaluation was considered very important because costs and benefits for society and policymakers should be evident. Therefore, the CSIRO framework was selected and adapted to evaluate the *CF - program eHealth*. The section 'communication technologies' was left out since this aspect was considered of lesser importance for evaluating the *CF - program eHealth*.

In Appendix C. one can find the 'adapted CSIRO evaluation framework' with the details of two projects of the *CF – program eHealth* as example cases. Each project aimed to contribute to one or more of the program deliverables. The black circles indicate which deliverables were selected at the start of each project. During the evaluation of each project, the black circle in the column of the deliverable will be filled with the colours red, orange, or green, depending on the level of accomplishment of the deliverable. A red colour indicates that the project failed to accomplish the deliverable, orange means partial completion, and green indicates a successful accomplishment of the deliverable. A steering committee consisting of representatives of all eight UHs determined if and to what extend projects contributed to the program deliverables. Through systematically mapping all projects, the outcomes of each project can be easily viewed and an overview will be created to see the accomplishment of the program deliverables.

Step 3: Development of mixed methods study

The aim of Step 3 was to develop a mixed-methods study in order to evaluate the eHealth project progress indicators in relation to the eHealth projects of the *CF – program eHealth*. As a result of the rapid review carried out in Step 1, the seven aspects planning, needs assessment, policy/organization, technology, ethics, legal, and finance, were selected as indicators for monitoring the progress during the development and implementation phases of an eHealth project (Fig. 2, Appendix B). The project leaders of the

eHealth projects of the *CF - program eHealth* were each subjected to a self-developed questionnaire, evaluating the eHealth project progress indicators in relation to the progress of their project in more depth. The questionnaire consisted of two parts. Part one had to be completed at mid-term (52 questions) and part two at end-term (55 questions) of each project. With this longitudinal aspect, we aimed to evaluate the change of magnitude of the indicators over time. Topics included respondent demographics and items related to the eHealth project progress indicators. Various question formats were used, including: yes/no, multiple-choice and four-point Likert-scale questions. Also, there was a textbox for remarks next to each question. All the questions, except for the last one, which asked if there are additional comments, were mandatory. The questionnaire was completed in the online survey service software of SurveyMonkey.[21] The project leaders received an email with link to questionnaire and reminder emails were sent after three and five weeks. Quantitative questionnaire data were analysed by calculating descriptive statistics using Excel. Continuous data were summarized using means and standard deviations. Categorical data were presented as frequency counts with percentages.

In addition to the questionnaire, one randomly selected project leader from each UH was interviewed by the coordinating researcher (AR) to explore the role of the project progress indicators in relation to their project more in depth at the end of the *CF-program eHealth*. The semi-structured interview followed an interview guide, with a subset of open questions per project progress indicator and allowed an iterative approach. The same set of questions was used in all interviews, and if necessary, adjusted along the way. The interview guide was composed with input from the results of the questionnaire. It was estimated that saturation was reached after eight interviews, however, if saturation was not reached, more project leaders were interviewed. The interviews were held by telephone, digitally recorded with the permission of the project leaders and transcribed verbatim. The transcripts will be analysed according to the six-step thematic analysis framework of Braun & Clark (2006).

Discussion

Evaluation study protocol development

We developed a generic evaluation protocol that is capable of evaluating an UHs eHealth program with various eHealth themes and projects, by using the *CF – program eHealth* as case study. The CSIRO evaluation framework was selected for evaluating of the government-initiated *CF – program eHealth*. The framework was esteemed capable of mapping the outcomes of each of the eHealth projects and to create a clear overview of the completion of the program deliverables.

Although we could not find an existing eHealth evaluation framework that was capable of evaluating an UHs eHealth program with various eHealth themes and projects as a whole, we purposely did not want to develop a new framework ourselves. To our believes, if it is possible to adjust an existing framework, valuable time can be saved and valuable methods can be recycled instead of wasted.

The seven aspects planning, needs assessment, policy/organization, technology, ethics, legal, and finance, were found to be useful indicators for monitoring progress of eHealth projects mainly during the development and implementation phases.

Additionally, a mixed-methods study, consisting of a questionnaire and a semi-structured interview, was developed to evaluate the seven progress indicators of eHealth projects in more detail.

Strengths and weaknesses

Despite the fact that we thoughtfully performed a rapid review of literature, we do reckon that this novel method is not comparable with the well-known systematic literature review. For instance, one could argue that results of the rapid review were incomplete and that not all of the existing eHealth program evaluation frameworks were encountered. However, by performing a rapid review we were able to complete our objectives of this study: finding a framework that is capable of evaluating an UHs eHealth program with various eHealth themes and projects, and determine eHealth project progress indicators. Also, eHealth is a relatively new field and limited research has been performed. Therefore, we estimated that a systematic literature review would yield little extra results. We do believe a literature search of any type is a very useful first step in gathering information, but should not exclusively be used to draw conclusions upon. Creativity is indispensable and should be embraced in order to adapt existing or develop novel methods to evaluate eHealth.

We were able to systematically determine eHealth project progress indicators that can monitor projects during development and implementation. Unfortunately, implementation of these indicators at the start of the *CF - program eHealth* could not take place, because the program already started before the evaluation protocol was developed. Therefore, the indicators will be retrospectively assessed instead of prospectively. As for eHealth programs in general, we recommend that this subset of indicators is implemented from the very beginning and monitored closely to support successful and efficient progress of eHealth projects.

Novelty and future suggestion

Undertaking independent, rigorous evaluations of government-led health technology programs is challenging but important in delivering results and gathering insights to inform policymakers and other stakeholders.[22] However, as to our knowledge, there are limited studies evaluating government-funded eHealth programs. Through our novel evaluation approach, consisting of the implementation of an adapted version of the existing CSIRO evaluation framework and a mixed-methods study, we want to set an example for other eHealth programs with various eHealth projects.

Several research groups depicted subsets of indicators for evaluating or monitoring eHealth solutions. For example, during a workshop with 43 European experts in 2011, excellent efforts were made to describe which type of eHealth indicators could monitor eHealth solutions after implementation.[23] More recently, Enam et al. reviewed several eHealth studies as cases and, similar to the research of Hypponen et al., they found that evaluation was mostly conducted at the end of development. Also, they noted great variability in standardization of eHealth evaluation making transferability of evidence among eHealth solutions difficult.[15] Eysenbach and the CONSORT-EHEALTH Group (2011) aimed to improve the quality of reporting eHealth trials with the CONSORT-EHEALTH statement and the authors Keizer and Ammenwerth (2008) aimed to improve quality of reporting of IT evaluation papers by providing researchers with a subset of ten quality indicators. As for our research, we focus on defining a subset of indicators that can be used to monitor progress of eHealth projects during the development and implementation phases. These indicators can also be used as part of a process evaluation to determine the progress of individual eHealth projects. Profound monitoring enables making necessary adaptations early the developmental process of a project. Early adaptations may prevent waste of time and money, and through continuous evaluation, the best possible quality of an eHealth project will be pursued. Pre-

cise project monitoring also enables policymakers to make decisions to continue, terminate, or modify health programs.[11]

As for future research it would be interesting to investigate how subsets of indicators of 'monitoring during development and implementation' (this article), 'monitoring after implementation' (Hypponen 2013), and 'reporting of trials / papers' (Eysenbach 2011 / Keizer 2008) could be combined.[24] By combining subsets of indicators quality of eHealth solutions could be improved and thereby the success rate of long-term use enhanced.

Conclusion

By following a three-step methodology, we systematically gathered valuable insights on eHealth evaluation frameworks and eHealth project performance indicators in general. These findings can support researchers evaluating eHealth programs with various eHealth projects. The eHealth project progress indicators can be used by researchers or policymakers to monitor the progress of eHealth projects during the development and implementation phases. Finally, a subsequent study will implement the developed evaluation study protocol to determine the successes and lessons of the *CF – program eHealth*.

CRediT authorship contribution statement

Anneloek Rauwerdink: Conceptualization, Investigation, Methodology, Data curation, Formal analysis, Writing - original draft, Writing - review & editing. **Marise J. Kasteleyn:** Supervision, Writing - review & editing. **Niels H. Chavannes:** Supervision, Writing - review & editing. **Marlies P. Schijven:** Supervision, Data curation, Writing - review & editing. **:** .

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Ethical approval

Not required.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ceh.2020.12.002.

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