


Value of a Nationwide University Network in scaling up telemonitoring: a qualitative study

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To cite: Gijsbers H.JH, Nurmohamed SA, Dusseljee - Peute LW, *et al.* Value of a Nationwide University Network in scaling up telemonitoring: a qualitative study. *BMJ Health Care Inform* 2025;**32**:e101320. doi:10.1136/bmjhci-2024-101320

► Additional supplemental material is published online only. To view, please visit the journal online (<https://doi.org/10.1136/bmjhci-2024-101320>).

Received 03 October 2024
Accepted 26 March 2025

ABSTRACT

Objectives The adoption and subsequent implementation of telemonitoring across university hospital settings is a challenging task. This study provides insight into the perceived value of using a nationwide network to support scaling up telemonitoring in university hospitals.

Methods A qualitative approach was used to evaluate the role of the National eHealth network 'Citrien eHealth programme Implementation and Upscaling (Citrien-2)'. In phase 1, an inventory questionnaire was used to identify successes and lessons learnt. Phase 2 consisted of a semi-structured group interview to develop a deeper understanding about the potential value of the network. Subsequently, we conducted a qualitative content analysis and results were organised into key themes of the non-adoption, abandonment, scale-up, spread and sustainability framework.

Results In total, 20 participants responded to our questionnaire, and 7 participants participated in our semistructured group interview. Qualitative analysis revealed 28 themes. The network's key value is the collaboration and structured approach it promotes. This serves as a foundation for exchanging ideas, identifying both temporary and sustainable funding, and establishing a robust stakeholder position, all of which serve to act as a catalyst for implementation and scaling up of telemonitoring.

Discussion Our findings align with known barriers to digital innovation, such as funding and legal issues. Our study shows the value of a nationwide network in overcoming these barriers.

Conclusions The Citrien-2 nationwide network contributes to scaling up telemonitoring across university settings. Therefore, we recommend that governments and their funding agencies recognise and embrace the power of these nationwide networks in scaling up digital initiatives.

INTRODUCTION

Telemonitoring (TM) represents a promising tool for effectively managing care remotely, with the potential to reduce associated travel costs and alleviate difficulties in accessing primary healthcare for patients.^{1–3} TM is defined as “the collection, transmission, evaluation and communication of individual health data from a patient to their healthcare

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Many eHealth implementation studies look at the barriers, facilitators and strategies for individual healthcare professionals. However, nationwide eHealth implementation success is influenced by factors such as funding and technology. A network-based approach could encourage collaboration and knowledge sharing but has not yet been explored for nationwide scale-up of telemonitoring.

WHAT THIS STUDY ADDS

⇒ This study explored the value of an implementation network in scaling up telemonitoring. The network approach was seen as strongly supporting collaboration, ensuring accountability and providing support in finding the right prerequisites for scaling up, as well as helping to overcome barriers such as regulatory issues and reimbursement.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Challenges remain, such as the need for greater attention to organisational readiness assessment and evaluation methods. As the transition to digital health continues, it is recommended that governments, funding agencies, professional bodies, umbrella organisations, health insurers and university hospitals embrace the power of these nationwide networks, making it a prerequisite for scaling up digital initiatives such as telemonitoring.

provider or extended care team from outside a hospital or clinical office (ie, the patient's home) using personal health technologies including wireless devices, wearable sensors, implanted health monitors, smartphones and mobile apps'.⁴ TM is classified by the WHO as part of the concept of eHealth, which in turn is nested as a concept of digital health.⁵

Moreover, TM has the potential to deliver high-quality, accessible and sustainable healthcare.^{6–10} Healthcare providers increasingly recognise the benefits of implementing such solutions to that end.^{11–13} However, research focused on its implementation is limited.¹⁴ The success rates of various eHealth solutions,



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including TM, remain largely unknown. Approximately half of all articles on the implementation of these types of solutions report failures.¹⁵ However, there may be biases against the publishing of failures.^{16 17} Their implementation and scaling up are challenging due to a diverse set of barriers. These barriers include technological, behavioural, medicolegal and organisational factors.^{3 18–20} Scaling up is defined by the WHO as ‘deliberate efforts to increase the impact of successfully tested health innovations so as to benefit more people and to foster policy and programme development on a lasting basis’.²¹ Successful implementation and scale-up of innovations is closely tied to social acceptance.²² For instance, adopting TM demands significant time, effort, skills and financial resources from healthcare professionals and their organisations.^{19 20 23} Its implementation often leads to increased workload or workforce issues or requires adjustments to the role of healthcare providers.^{19 23–25} While many studies focus on individual healthcare professionals’ barriers, facilitators and implementation strategies,^{26 27} national eHealth implementation success is influenced by factors beyond the individual, such as funding and technology requirements.

Therefore, a network-based approach could be more effective. For example, this approach could foster collaboration and knowledge sharing.^{28–30} Also, cross-sectoral interdisciplinary stakeholder engagement has emerged as a potential catalyst for implementation success.³¹ However, the value of a network-based approach remains underexplored in reviews concerning the scale-up of digital health systems.^{20 27}

In the Netherlands, the Ministry of Health, Welfare and Sport has requested University Medical Centres (UMCs) to lead the transformation of healthcare. This is being achieved through collaboration in a national health programme under the governance of the Netherlands Federation of UMCs. The aim is to effectively scale up eHealth, while addressing all relevant barriers and facilitators for implementation.³² The UMCs collaboration within the ‘Citrien eHealth programme Implementation and Upscaling (Citrien-2)’ started in 2019, with a network of project leaders and steering committee members from each UMC.³³

It was envisioned that support of a properly governed national network may facilitate implementation of TM and, more specifically, help to implement this solution for cardiac patients, antenatal care and vital signs monitoring across university hospitals. The purpose of this research

is to gain insight into the perceived added value of a network-based approach in implementation and scale-up of these TM technologies.

METHODS

Study design and setting

A qualitative design in two phases was used to evaluate the perceived value of the network ([figure 1](#)). To gain insight into the potential value of the network, first a questionnaire was distributed among members of the Citrien eHealth network. Here, perceived successes and lessons learnt in the Citrien-2 programme were explored. Next, resulting topics from the questionnaire were analysed deeper by means of a semistructured group interview (SSGI) with a focus on the role and value of the network in this programme. A content analysis method was used to analyse the data.³⁴ In this study, the Consolidated Criteria for Reporting Qualitative Research checklist was followed (online supplemental file 4).³⁵ This qualitative study is complementary to a quantitative study on healthcare professionals’ evaluation of TM and its actual uptake numbers within the Citrien-2 programme and is published separately.³⁶

Recruitment of participants

All members of the Citrien-2 programme steering group (n=16) and project leaders (n=8) from each UMC were invited to complete the questionnaire. Thus, a total of 24 participants were invited to participate in this phase. All eight Citrien-2 project leaders were recruited for a group interview. The aim was to ensure full representation of all UMCs in both steps of this study.

Questionnaire

In this phase, the successes and lessons learnt from the Citrien-2 programme were identified using a questionnaire, sent by email. (online supplemental file 1). To identify the successes and lessons learnt from all the different phases of the implementation process, Grol and Wensing’s classification of the five stages was used to structure the inventory form.³⁷ In this phase, all steering committee members and project leaders were asked to complete the inventory. The researchers (HG and TvdB) requested a response in a compiled single document per UMC. The researchers then collated and analysed the data from each of the UMCs in question. To identify common topics and differences, all responses were

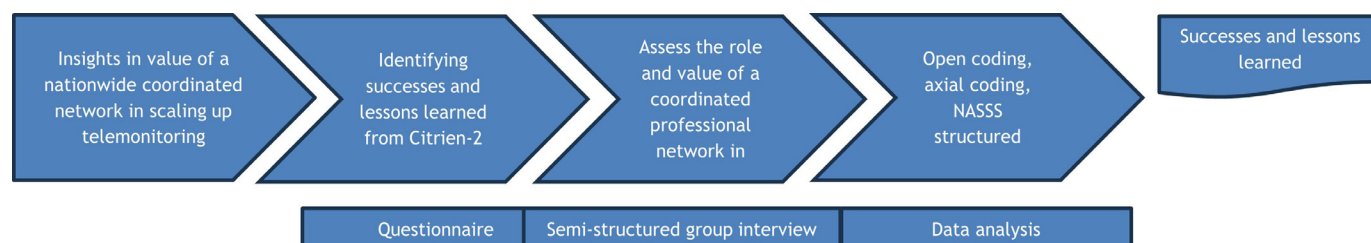


Figure 1 Overview of methods. NASSS, non-adoption, abandonment, scale-up, spread and sustainability.

summarised and checked for discrepancies. Any ambiguities or inconsistencies were noted and used as input for the SSGI guide to allow deeper analysis.

Semistructured group interview

All project leaders from the UMCs participated in the SSGI. Everyone who took part did so voluntarily. The purpose of the group interview was to inductively explore the perceived (added) value of the Citrien-2 network for the implementation and scaling-up of TM in Dutch UMCs. Participants were informed in advance about the purpose of the interview and how it would be conducted. Information on different stages of implementation and different issues related to the perceived value of a network was extracted. Therefore, the method conducted is best described as SSGI.

The five-stage classification proposed by Grol and Wensing was employed as a guide to semistructure the group interview (online supplemental file 2). This ensured that the value of the network was explored at all stages of the implementation process.³⁷ To allow probing questions, the interview guide also included open-ended questions. The interview was performed on 4 October 2022 and took place in a meeting room centrally located in Utrecht, the Netherlands. The SSGI was led by the first author (HG), a health informatician with experience

in SSGI. The last author (TvdB) listened to the entire recording and took notes independently of the SSGI. Consent was obtained to record audio for verbatim transcription and data processing. To stimulate further narratives and to clarify and enhance understanding, probing open-ended questions were used. The group discussion also included the opportunity for the participants to share further experiences of their own.

Data analysis

The SSGI was analysed based on directed qualitative content analysis.³⁴ The transcript of the interview was examined independently by two researchers (HG and TvdB). Following independent coding, a deductive approach was employed to categorise the codes into themes and structure them within the domains of the framework for non-adoption, abandonment, scale-up, spread and sustainability, the NASSS framework. The NASSS framework consists of seven domains and is designed to identify activities such as those performed by Citrien-2 within a complex context from local adoption to sustainable national scale-up.³⁸

All themes were discussed until consensus about the final classification of themes was reached.

Data extraction, open coding and revision of categories were performed using the software package for qualitative

Table 1 Participant characteristics

Participant	Gender	UMC	Occupation	Role for Citrien-2	Age category	Questionnaire	SSGI
Participant 1	M	UMC#6	Senior researcher in epidemiology	SG	41–50	x	x
Participant 2	F	UMC#6	Assistant professor eHealth	PG	31–40	x	
Participant 3	F	UMC#1	Gynaecologist	SG	41–50	x	
Participant 4	M	UMC#1	Programme manager digital health	PG	31–40	x	x
Participant 5	M	UMC#5	Professor appropriate care	SG	51–60	x	
Participant 6	M	UMC#5	Senior researcher	SG	31–40	x	
Participant 7	F	UMC#5	Radiologist	PG	51–60	x	x
Participant 8	F	UMC#3	Paediatrician	SG	31–40	x	
Participant 9	M	UMC#3	Dermatologist	PG	41–50	x	
Participant 10	M	UMC#2	Professor general medicine	SG	41–50	x	
Participant 11	F	UMC#2	Assistant professor	SG	31–40	x	
Participant 12	F	UMC#2	Senior researcher	PG	31–40	x	x
Participant 13	F	UMC#4	Professor of surgery	SG	51–60	x	
Participant 14	F	UMC#4	Assistant director EHR service team	SG	41–50	x	
Participant 15	M	UMC#4	Physical therapist, junior researcher	PG	31–40	x	
Participant 16	F	UMC#4	Professor psychosocial oncology	SG	51–60	x	
Participant 17	M	UMC#7	Radiologist	SG	41–50	x	
Participant 18	F	UMC#7	Strategic policy advisor	PG	20–30	x	x
Participant 19	F	UMC#4	Psychologist	SG	41–50	x	x
Participant 20	M	UMC#4	Junior researcher	SG	20–30		x

EHR, Electronic Health Record; PG, project leader and project group; SG, steering group; SSGI, semistructured group interview; UMC, University Medical Centre.

data analysis and mixed methods research MaxQDA (MAXQDA Analytics Pro, VERBI Software, 2020).

RESULTS

This section describes the characteristics of the participants. Subsequently, the questionnaire results, including successes and lessons learnt, are presented. Finally, the results of the SSGI will be discussed.

Participant characteristics

In total, 20 participants were involved in both phases of the study. The mean age was 42 years. 13 participants were members of the steering group, and 7 were project leaders. 19 participants from all UMCs completed the questionnaire. Seven participants joined the SSGI. All UMCs were represented in both steps. The characteristics of respondents are given in [table 1](#).

Results from the questionnaire

Successes

A summary of all successes and lessons learnt is given in [box 1](#). The Citrien-2 programme focused on TM rather than specific solutions, encouraging a flexible approach to customised solutions at each UMC. As one of the steering group members stated:

Participant 7 (UMC#5): *Very important was the policy of the Citrien programme to adopt the concept of telemonitoring, instead of the solution, technology or manufacturer. As a result, the view remained wide and the most suitable solution was chosen for each UMC.*

In 2019, project leaders gained support from healthcare professionals for TM through knowledge exchange and best practices. A collaborative project canvas helped identify objectives, methodology and barriers. The Citrien-2 eHealth programme provided financial and in-kind support, promoting knowledge exchange and healthy competition among UMCs. Financial and regulatory barriers hindered scaling up TM, so input from healthcare insurers and the Dutch Healthcare Authority was considered. Monthly progress updates from project leaders maintain accountability and aid in evaluating and scaling up TM initiatives within the Citrien-2 network.

Lessons learnt

Respondents noted varying TM requirements between UMCs, due to differing academic profiles, IT infrastructure, work processes and supplier agreements. Steering committee and project leaders also observed more variation between departments and medical conditions than expected. Recognising these differences is crucial as a 'one-size-fits-all' approach is ineffective. Rigorous problem analysis and assessment of organisational readiness are essential. Including an evaluation paragraph in the Project Canvas was recommended. Future eHealth programmes should also include cost-effectiveness studies.

Box 1 Overview of successes and lessons learnt from the inventory

Orientation

Successes

- ⇒ Our eHealth solution was developed for and by healthcare providers. The solution was, therefore, also a real solution. Gaining support was also of decisive importance, which is exactly what these people could do best. So when you start with eHealth implementation, make sure that it is 'for and by' end users.
- ⇒ Very important was the policy of the Citrien programme to adopt the concept of telemonitoring, instead of the solution, technology or manufacturer. As a result, the view remained wide and the most suitable solution was chosen for each UMC. Keep your eyes wide open and do not be afraid to use different or newer technologies.
- ⇒ A major success of the Citrien network was to create support for telemonitoring during the phase of orientation back in 2019.
- ⇒ The fact that the target population was selected by the medical profession itself was an essential success element.
- ⇒ UMCs released their 'not invented here syndrome' during this Citrien programme. That made this a unique collaboration.
- ⇒ The completion of the project canvas with the internal project team has allowed us to rapidly identify and agree on the goals, methodology, risks, scope and dependencies in all projects. In addition, the project canvas was useful for informing stakeholders.

Lessons learnt or areas for improvement

- ⇒ The differences in needs per department and/or medical conditions were greater than expected. The lesson learnt is to not underestimate this. Implementation is not one-size-fits-all. Recognise that differences exist.
- ⇒ It was assumed that all UMCs had the same problem definition. The selection of upscaling initiatives in this Citrien programme was primarily based on successful pilots, which is more innovation-driven than problem-oriented.
- ⇒ An area for improvement is to conduct an ICT maturity scan within each organisation prior to implementation. We could have estimated whether there was additional complexity related to ICT immaturity.
- ⇒ Although it was positive that each UMC was given the option of selecting an application for which there was significant support (both among medical specialists and the IT department), there remained a risk of ineffectiveness. It is more complicated to learn and collaborate when various solutions are chosen.

Insight

Successes

- ⇒ Some nurses expressed a lot of concern. It was beneficial to introduce technology in selected patient rooms as early as possible so that nurses could experience how it operated first-hand.
- ⇒ Innovation and creation were prioritised in Citrien 1. It continued on a modest scale and in a testing environment. We have now genuinely moved towards a national scale.

Lessons learnt or areas for improvement

- ⇒ There is potential for improvement within the baseline measurement process. The baseline assessment must occur right from the start of the programme.
- ⇒ Early consensus on the outcome indicators to be measured is an area for improvement.

Acceptance

Successes

- ⇒ A short evaluation cycle is a huge success. Begin pilots as soon as possible to collect a variety of issues including people, technical

Continued

Box 1 Continued

(malfunctions) and environmental (financing). You can avoid complications by learning how to adapt to new technology in a pleasant manner.

- ⇒ The project canvas is demonstrated to be useful for problem analysis.
- ⇒ Each UMC has developed its own system for identifying barriers and enablers. This could be considered as an advantage.
- ⇒ Engage with innovators and early adopters, then distribute success tales.
- ⇒ An enabling factor was the availability of financial resources from the Citrien eHealth programme to launch the projects. As a result, departments were not required to make funding available immediately.
- ⇒ It is critical to share experiences through the Citrien network. It helps if you can mention something like, 'in UMCx they use this method, and in UMCy they use that method.' It encourages healthy competitiveness.
- ⇒ We learnt from the experiences of others. We needed to make modifications so that it worked well with the processes in the adoptive UMC. Involving specialists in the design of the care path and procedure, as well as establishing training courses, is a key success factor.
- ⇒ Integrating new technology into current workflows as much as feasible is an essential enabler.
- ⇒ Discussing financial and regulatory challenges to scaling up telemonitoring with a mirror group of healthcare insurers and the Dutch Healthcare authority is a success element.
- ⇒ We made a significant contribution to the Dutch Health Insurance Companies' Telemonitoring Guidelines.
- ⇒ The exchange of organisational interventions was a success. A central monitoring centre, for example.

Lessons learnt or areas for improvement

- ⇒ The execution of the problem analysis is an area for improvement. We should hold ourselves more accountable for our analyses within the network.
- ⇒ The elements of the target group are not considered in the creation. Consider the early adopters against the late majority.
- ⇒ The application of the NoMAD questionnaire in the problem analysis is an unused opportunity.
- ⇒ In these types of projects, it is particularly important to assess organisational readiness.
- ⇒ Before starting a project, ensure that the supplier's planning expectations are met.
- ⇒ It has been challenging to collaborate in reaching financial arrangements with suppliers.

Change

Successes

- ⇒ Seven departments began adopting monitoring, leading to the internal formation of a steering group for monitoring. This requires upscaling that is structured and effective. It is advised that you form a diverse steering group that meets frequently when scaling up.
- ⇒ By sharing monthly updates on their progress, project leaders keep each other on their toes.
- ⇒ Sharing experiences is one of the benefits of networks. We shared our experiences with the many sensors UMCs used in the TM vitals project throughout the project leaders' and steering group's meetings.
- ⇒ Joining this network was a success because it linked up with existing structures to accelerate upscaling.

Continued

Box 1 Continued

- ⇒ The Citrine eHealth programme's additional financial support was a facilitator.

Lessons learnt or areas for improvement

- ⇒ The beginning of a telemonitoring project may provide significant technical difficulties. Starting small and phasing in the implementation is a successful strategy for overcoming any potential technical challenges.

Maintenance

Successes

- ⇒ Major change initiatives, such as the Citrien programme, take time. The executive board's support is crucial, providing both time and financial support for scaling up.
- ⇒ Structured funding is required to ensure the long-term viability of telemonitoring. We shared our experiences with structural finance implementation at project leaders and steering group meetings. It was also advantageous that the Citrien programme had a delegate in the Dutch Healthcare authority's telemonitoring working group, so that we could be informed and provide input for the structural funding of telemonitoring for (chronic) care pathways.
- ⇒ Involve the Care Contracting Department and the Executive Board early so that telemonitoring can be included in agreements with health insurance.
- ⇒ A key success factor is that critical preconditions for telemonitoring are sought and established in all UMCs. (Legal, administrative, and organisational)

Lessons learnt or areas for improvement

Evaluation

Successes

- ⇒ We were able to learn from each other's experiences by exchanging the (scientific) findings of evaluations and research conducted for the Citrien programme eHealth.
- ⇒ The organised manner of the Citrien network was useful for evaluating upscaling collectively.

Lessons learnt or areas for improvement

- ⇒ A recommendation for future eHealth programmes is to undertake cost-effectiveness research based on actual adoption.
- ⇒ Each UMC has defined their own outcome measures in their project canvas, as well as SMART goals for evaluation. This has not been coordinated. An essential lesson learnt is to agree on the outcome markers so that the outcomes may be compared.
- ⇒ The ability to evaluate is an area for development. It is advised to include an evaluation paragraph in the project canvas. TM, telemonitoring; UMC, University Medical Centre; SMART, Specific-Measurable-Achievable-Relevant-TimeBound; NoMAD, NOrmalisation MeASURE Development questionnaire; ICT, Information and Communication Technology; IT, Information Technology.

Results from the SSGI

The interview lasted 97 min. From the group interview, 28 themes were derived (figure 2). Online supplemental file 3 gives an overview of all codes, themes and categorisation according to the NASSS framework.

The added value of the Citrien-2 network is reflected in this section in the structure of the NASSS framework. The network provides cross-domain benefits, including encouraging the sharing of ideas and actively exchanging documents, fostering collaboration, incorporating project

The value of the Citrien-2 network (outer circle) within the NASSS domains (inner circle)

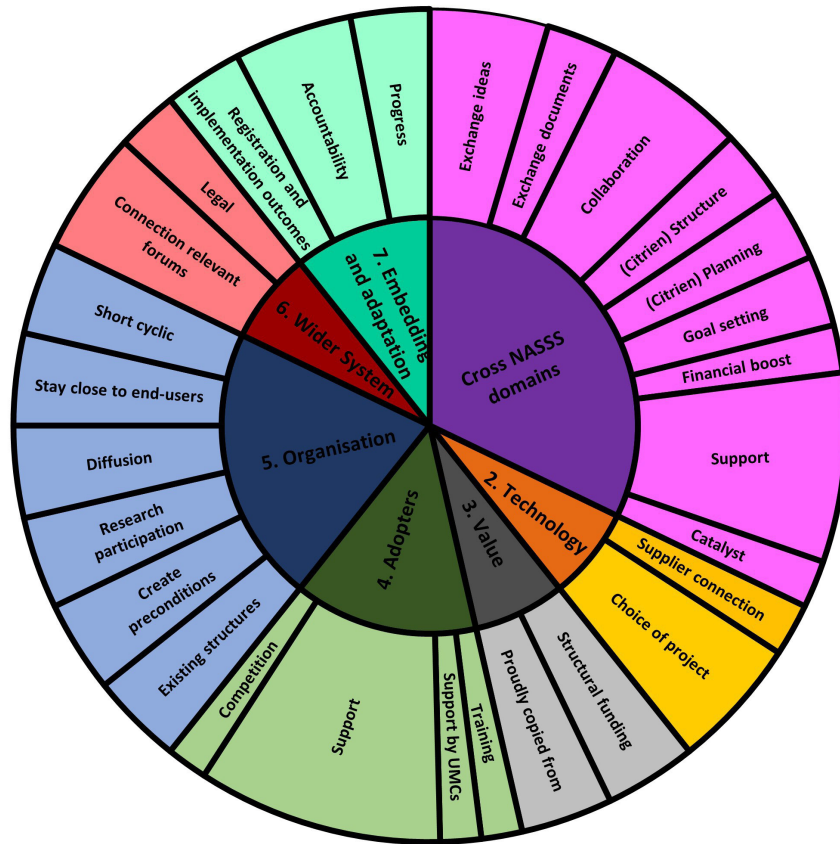


Figure 2 All 28 themes that were derived in this study in the outer circle, categorised by the NASSS framework in the inner circle. The size of the boxes indicates the amount of codes for each theme. NASSS, non-adoption, abandonment, scale-up, spread and sustainability.

management from Citrien-2, offering either financial or in-kind support and encouraging the purchase of devices with a financial boost.

Participant 18 (UMC#7): (...)by linking up with existing structures, with additional financial support from the Citrien ehealth programme, we were able to accelerate scaling up.

More, in general, participants appoint the Citrien-2 network as a catalyst for scaling up TM.

Domain 1: nature of the condition

No added value was observed from the network in this domain. The SSGI participants found it valuable that they could choose their own target group or condition within the programme's framework.

Domain 2: technology

Through the Citrien-2 eHealth network, UMCs engaged in joint discussions with suppliers, resulting in a stronger negotiating position. Citrien-2 focused on concepts rather than specific technologies, allowing for an appropriate choice to be made for each UMC.

Domain 3: value proposition

The network has an important added value in that structural funding could be prepared through national cooperation with organisations such as the umbrella organisation of health insurers in The Netherlands, known as Zorgverzekeraars Nederland. Additionally, the Citrien-2 programme builds on the Citrien-1 programme, which had already evaluated TM projects for their effectiveness and value to patients and healthcare providers. Rather than initiating new projects, the Citrien-2 programme mandates the adoption of successful projects from other UMCs. This created a

Participant 13 (UMC#4) (...) *proudly copied' attitude instead of a 'not-invented-here' attitude*

Domain 4: adopters

The Citrine-2 network provides valuable support for project leaders and healthcare providers in the workplace. For instance, the network facilitates the education of healthcare professionals in the use of TM. Additionally, the network fosters a sense of togetherness among

professionals, providing them with the necessary support. The commitment of UMCs to Citrien-2 radiates its importance. The added value of the network was also evident in the healthy sense of competition observed during the SSGI.

Participant 7 (UMC#5): *It is helpful to provide specific examples, such as how UMC x and UMC y approach the task, to encourage healthy competition.*

Domain 5: the organisation

The Citrien-2 network provides important added value by seeking and finding important preconditions in all UMCs to secure TM. For instance, the network accelerates scaling up by joining projects or participating in research.

Participants in the SSGI identified the implementation method shared within the network as a best practice and an important added value. It is recommended to start on a small scale with the innovators and early adopters and to disseminate the success stories.

Participant 4 (UMC#1): *Pilots should be conducted continuously, for example, by setting up one patient room with monitoring and allowing interested parties to use it. This approach facilitates learning through play.*

Participants stated that organisational readiness was insufficiently assessed, or at least not coordinated, within in the Citrien-2 network.

Domain 6: the wider system

In the wider system domain, participants indicated that there was a role for the network in initiating structural funding by health insurers and a legal framework for TM.

Participant 18 (UMC#7): *It was useful that we had a delegation in the telemonitoring working group of the Dutch Health Care Authority, which meant that we were informed and could provide input for structural funding.*

Domain 7: embedding and adaptation over time

One of the primary benefits of the network is being accountable to others outside one's own UMC. As stated by participants:

Participant 19 (UMC#4): *That you do reflect more on how others are doing and that, for example, from the programme you are asked for the uptake statistics. Well apparently that is something very difficult. I wonder if that would ever come to the surface if we hadn't asked for it from the programme.*

DISCUSSION

The objective of this study was to investigate the perceived value of an implementation network in scaling up TM from the perspective of the members of Citrien-2, using a questionnaire and an SSGI. We found that the network approach in Citrien-2 was perceived as strongly supporting collaboration. It ensured that members were accountable

to each other and provided support in finding the right prerequisites for scaling up. It is also a valuable contribution to overcoming barriers, such as regulatory issues and reimbursement. These combinations of benefits were viewed on as catalysts for implementation and scaling up.

This is in line with the Dutch government's stated societal mission to provide care at a distance wherever possible.³² The role of acting as an innovation catalyst also fits in with the role that the UMCs see for themselves in optimising innovation through networking.^{39 40}

Comparison with other literature on networks and readiness

Our findings align with known barriers to scaling up digital innovations, such as funding and legal issues. Our study highlights the role of nationwide networks to overcome such barriers for implementation and scaling up.^{41 42} Comparable to our findings, previous studies link knowledge-sharing networks to better healthcare service quality.^{43 44} Participation in a clinically integrated network (CIN) is associated with remote patient monitoring, improved care quality, reduced costs and robust IT infrastructure.⁴⁵ Although the Citrien-2 network is not a CIN, it shares similar features and benefits.

As the study participants pointed out, organisational readiness had not been sufficiently assessed and discussed in the network. There is evidence from literature that assessing organisational readiness and ICT maturity can improve TM scalability.^{20 46} This area for improvement did not diminish the network's overall value, but it was suggested as an enhancement to the programme's content and implementation.

Strength and weakness

The group interview after the questionnaire was a major advantage of this study, allowing a detailed discussion of the answers, such as the role of Citrien-2 in fulfilling financial support.

This study might be subject to limitations. First, this study has a limited group of participants and uses only one SSGI. Thus, it is not possible to draw any conclusions about data saturation. Second, participants in this study were network participants. It could be argued that this is not a fully independent evaluation.

To determine rigour in SSGIs, comprising both validity and reliability, strategies like a coding system, inter-rater reliability and triangulation are advised.^{47 48} This study used independent coding by two researchers, with one blind to the interview's context. A final coding and classification of themes was achieved through a thorough process of consultation and consensus. The use of two methods and the coding process ensures the validity of the findings. In addition, an independent report commissioned by the funding agency concludes that Citrien-2 has achieved valuable impact in the wider healthcare field, including improvements in efficiency, accessibility and availability and confirms our results on implementation and scaling-up barriers.³⁶

The present study surveyed all members of the Citrien-2 network, covering all Citrien-2 TM projects in UMCs in the Netherlands, mapping a comprehensive overview of relevant factors. Therefore, we believe it is highly relevant to describe the added value from that perspective.

A potential limitation of this study is the retrospective use of the NASSS framework to interpret the value of the network for implementation. The intended use of the NASSS was to retrospectively interpret complexity or explain failures.³⁸ Nevertheless, the NASSS is more often used to retrospectively assess implementation.^{49 50}

This study did not assess whether the network also influenced clinical outcomes, as the government's mandate to the Citrien-2 programme was to scale up existing innovations rather than to start more and new research. The implementation of new technology can be enabled by the presentation of scientific evidence demonstrating its value (domain 3) to patients or the healthcare system. Conducting scientific research is very much in line with the mission of the UMCs. Therefore, research was undertaken within the TM initiatives of the Citrien-2 programme, although this was not the programme's primary objective.

For future research, it may be relevant to conduct social network analysis to explore patient perspectives and specific network features important to its value.^{30 51 52}

Implications for practice

From the perspective of our participants, UMCs have traditionally been seen as competitors.⁵³ A well-organised nationwide network of UMCs promotes better cooperation and exchange of best practices. According to this study, the next essential step to scaling up digital healthcare innovations like TM is to set up more nationwide networks as critical accelerators.

CONCLUSIONS

In conclusion, the Citrien-2 programme has been valuable in promoting TM initiatives within Dutch (UMCs). The programme's approach of facilitating collaboration among UMCs, providing financial and in-kind support, and encouraging knowledge-sharing has led to notable achievements including the establishment of TM support and the acceleration of scaling-up efforts. However, challenges also exist, such as the need for greater attention to organisational readiness assessment and evaluation methods. Overall, our findings indicate that a network like Citrien-2 provides a valuable model to stimulate nationwide collaboration and overcome barriers for scaling up digital applications. As the transition to digital health continues, it is recommended that governments, funding agencies, professional bodies, umbrella organisations, health insurers and university hospitals embrace the power of these nationwide networks, making it a prerequisite for scaling up digital initiatives such as TM.

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Acknowledgements The authors wish to thank Ms B van Dort, PhD, for her critical review on grammatical errors.

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Contributors Conceptualisation: MPS and Tvdb. Study design: HG and Tvdb. Data collection and storage: HG. Data analysis: HG, Tvdb and LWD. Writing original draft: HG. Writing—review and editing: Tvdb, SAN, LWD and MPS contributed to the refinement of the paper. All authors have read and approved the final paper and agree to be accountable for all aspects of the work. Guarantor: Tvdb.

Funding The Citrien-2 programme is funded by ZonMW (Care Research Netherlands, Dutch abbreviation: ZON, Medical Sciences, Dutch abbreviation: MW) projectnumber: 839205004. ZonMw programmes and funds research and innovation in health, healthcare and well-being, encourages the use of this knowledge and highlights knowledge needs. ZonMW is an independent government body and has no role or involvement in this research.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval The study was conducted according to the ethical principles outlined in the Declaration of Helsinki (World Medical Association, 2008). The Medical Ethics Committee of Amsterdam UMC reviewed the study protocol and decided that the study did not fall under the scope of the Dutch Medical Research Involving Human Subjects Act (Statement nr: 2023.0208).

Provenance and peer review Not commissioned; internally peer reviewed.

Data availability statement Data are available on reasonable request. Codes and themes are available in online supplemental file 3. The transcript of the SSGI is available on request.

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REFERENCES

- 1 Meystre S. The current state of telemonitoring: a comment on the literature. *Telemed J E Health* 2005;11:63–9.
- 2 Field MJ, ed. *Telemedicine: a guide to assessing telecommunications for health care*. Washington, DC: The National Academies Press, 1996:288

- 3 Leo DG, Buckley BJR, Chowdhury M, *et al*. Interactive Remote Patient Monitoring Devices for Managing Chronic Health Conditions: Systematic Review and Meta-analysis. *J Med Internet Res* 2022;24:e35508.
- 4 ATA. Telehealth: defining 21st century care. 2020.
- 5 WHO. Classification of digital health interventions. WHO Geneva; 2018.
- 6 EU. Communication from the commission to the European parliament, European economic and social committee and the committee of the regions on enabling the digital transformation of health and care in the digital single market; empowering citizens and building a healthier society. 2018.
- 7 European Commission. Digital health and care - transformation of health and care in the digital single market. 2018.
- 8 Eurostat. Healthcare expenditure. 2021. Available: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Healthcare_expenditure_statistics#Developments_over_time
- 9 Blandford A, Wesson J, Amalberti R, *et al*. Opportunities and challenges for telehealth within, and beyond, a pandemic. *Lancet Glob Health* 2020;8:e1364–5.
- 10 Cripps M, Scarbrough H. Making Digital Health “Solutions” Sustainable in Healthcare Systems: A Practitioner Perspective. *Front Digit Health* 2022;4:727421.
- 11 Meurs M, Keuper J, Sankatsing V, *et al*. “Get Used to the Fact That Some of the Care Is Really Going to Take Place in a Different Way”: General Practitioners’ Experiences with E-Health during the COVID-19 Pandemic. *Int J Environ Res Public Health* 2022;19:5120.
- 12 Gijsbers HJH, Kleiss J, Nurmohamed SA, *et al*. Upscaling telemonitoring in Dutch University Medical Centres: A baseline measurement. *Int J Med Inform* 2023;175:105085.
- 13 Keij B, Versluis A, Alblas E, *et al*. E-healthmonitor 2023. Stand van zaken digitale zorg. In: *2023 eHealth Monitor: state of digital care*. Rijksinstituut voor Volksgezondheid en Milieu RIVM, 2024.
- 14 Rauwerdink A, Spinazze P, Gijsbers H, *et al*. Evaluation Approaches of Digital Health Technologies: A Systematic Analysis. *JMIR* 2023.
- 15 Granja C, Janssen W, Johansen MA. Factors Determining the Success and Failure of eHealth Interventions: Systematic Review of the Literature. *J Med Internet Res* 2018;20:e10235.
- 16 Heeks R. Health information systems: failure, success and improvisation. *Int J Med Inform* 2006;75:125–37.
- 17 Berg M. Patient care information systems and health care work: a sociotechnical approach. *Int J Med Inform* 1999;55:87–101.
- 18 Giebel GD, Speckemeier C, Abels C, *et al*. Problems and Barriers Related to the Use of Digital Health Applications: Scoping Review. *J Med Internet Res* 2023;25:e43808.
- 19 Schreiweis B, Pobiruchin M, Strotbaum V, *et al*. Barriers and Facilitators to the Implementation of eHealth Services: Systematic Literature Analysis. *J Med Internet Res* 2019;21:e14197.
- 20 Gijsbers H, Feenstra TM, Eminovic N, *et al*. Enablers and barriers in upscaling telemonitoring across geographic boundaries: a scoping review. *BMJ Open* 2022;12:e057494.
- 21 WHO. Scaling up projects and initiatives for better health: from concepts to practice. WHO Regional Office for Europe; 2016.
- 22 Pot F, Vaas F. Social innovation, the new challenge for Europe. *International Journal of Productivity and Performance Management* 2008;57:468–73.
- 23 Huygens MWJ, Voogdt-Pruis HR, Wouters M, *et al*. The Uptake and Use of Telemonitoring in Chronic Care Between 2014 and 2019: Nationwide Survey Among Patients and Health Care Professionals in the Netherlands. *J Med Internet Res* 2021;23:e24908.
- 24 Looman W, Struckmann V, Köppen J, *et al*. Drivers of successful implementation of integrated care for multi-morbidity: Mechanisms identified in 17 case studies from 8 European countries. *Soc Sci Med* 2021;277:113728.
- 25 Keyworth C, Hart J, Armitage CJ, *et al*. What maximizes the effectiveness and implementation of technology-based interventions to support healthcare professional practice? A systematic literature review. *BMC Med Inform Decis Mak* 2018;18:93.
- 26 Simblett S, Greer B, Matcham F, *et al*. Barriers to and Facilitators of Engagement With Remote Measurement Technology for Managing Health: Systematic Review and Content Analysis of Findings. *J Med Internet Res* 2018;20:e10480.
- 27 Varsi C, Solberg Nes L, Kristjansdottir OB, *et al*. Implementation Strategies to Enhance the Implementation of eHealth Programs for Patients With Chronic Illnesses: Realist Systematic Review. *J Med Internet Res* 2019;21:e14255.
- 28 Greenhalgh T, Abimbola S. The NASSS Framework - A Synthesis of Multiple Theories of Technology Implementation. *Stud Health Technol Inform* 2019;263:193–204.
- 29 Sheaff R, Schofield J. 434 inter-organizational networks in health care: program networks, care networks, and integrated care. In: Ferlie E, Montgomery K, Pedersen AR, eds. *The Oxford Handbook of Health Care Management*. Oxford University Press, 2016.
- 30 Saatchi AG, Pallotti F, Sullivan P. Network approaches and interventions in healthcare settings: A systematic scoping review. *PLoS One* 2023;18:e0282050.
- 31 WHO. From innovation to implementation - ehealth in the WHO European region. WHO Regional Office for Europe; 2016.
- 32 Bruins B. Kamerbrief Maatschappelijke rol van de UMCs. Den Haag; 2019.
- 33 Gijsbers H, Nurmohamed A, van de Belt TH, *et al*. The National Coordinated Citrien eHealth Program to Scale Up Telemonitoring: Protocol for a Before-and-After Evaluation Study. *JMIR Res Protoc* 2023;12:e45201.
- 34 Cho J, Lee E-H. Reducing Confusion about Grounded Theory and Qualitative Content Analysis: Similarities and Differences. *TQR* 2014.
- 35 Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care* 2007;19:349–57.
- 36 Boer S. *Eindevaluatie Citrienfonds 2019-2022*. Ministry of Health, Welfare and Sports, 2023.
- 37 Grol R, Wensing M. What drives change? Barriers to and incentives for achieving evidence-based practice. *Med J Aust* 2004;180:S57–60.
- 38 Greenhalgh T, Wherton J, Papoutsis C, *et al*. Beyond Adoption: A New Framework for Theorizing and Evaluating Nonadoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability of Health and Care Technologies. *J Med Internet Res* 2017;19:e367.
- 39 Desveaux L, Kelley LT, Bhatia RS, *et al*. Catalyzing Digital Health Innovation in Ontario: The Role of an Academic Medical Centre. *Healthc Policy* 2020;16:55–68.
- 40 DePasse JW, Chen CE, Sawyer A, *et al*. Academic Medical Centers as digital health catalysts. *Healthc (Amst)* 2014;2:173–6.
- 41 Schlieter H, Marsch LA, Whitehouse D, *et al*. Scale-up of Digital Innovations in Health Care: Expert Commentary on Enablers and Barriers. *J Med Internet Res* 2022;24:e24582.
- 42 Desveaux L, Soobiah C, Bhatia RS, *et al*. Identifying and Overcoming Policy-Level Barriers to the Implementation of Digital Health Innovation: Qualitative Study. *J Med Internet Res* 2019;21:e14994.
- 43 Cunningham FC, Ranmuthugala G, Plumb J, *et al*. Health professional networks as a vector for improving healthcare quality and safety: a systematic review. *BMJ Qual Saf* 2012;21:239–49.
- 44 Asthana S, Jones R, Sheaff R. Why does the NHS struggle to adopt eHealth innovations? A review of macro, meso and micro factors. *BMC Health Serv Res* 2019;19:984.
- 45 Pandit AA, Eswaran H, Bogulski CA, *et al*. Factors Associated with Remote Patient Monitoring Services Provision by Hospitals and Health Care Systems in the United States. *Telemed J E Health* 2023;29:1014–26.
- 46 Thijssen SV, Jacobs MJG, Swart RR, *et al*. The barriers and facilitators of radical innovation implementation in secondary healthcare: a systematic review. *J Health Organ Manag* 2021;ahead-of-print:289–312.
- 47 Morse JM. Critical Analysis of Strategies for Determining Rigor in Qualitative Inquiry. *Qual Health Res* 2015;25:1212–22.
- 48 Adeoye-Olatunde OA, Olenik NL. Research and scholarly methods: Semi-structured interviews. *J Am Coll Clin Pharm* 2021;4:1358–67.
- 49 Abimbola S, Patel B, Peiris D, *et al*. The NASSS framework for ex post theorisation of technology-supported change in healthcare: worked example of the TORPEDO programme. *BMC Med* 2019;17:233.
- 50 Fernando M, Abell B, McPhail SM, *et al*. Applying the Non-Adoption, Abandonment, Scale-up, Spread, and Sustainability Framework Across Implementation Stages to Identify Key Strategies to Facilitate Clinical Decision Support System Integration Within a Large Metropolitan Health Service: Interview and Focus Group Study. *JMIR Med Inform* 2024;12:e60402.
- 51 Hu H, Yang Y, Zhang C, *et al*. Review of social networks of professionals in healthcare settings-where are we and what else is needed? *Global Health* 2021;17:139.
- 52 Cheong LHM, Armour CL, Bosnic-Anticevich SZ. Primary health care teams and the patient perspective: a social network analysis. *Res Social Adm Pharm* 2013;9:741–57.
- 53 Hoogervorst JF, Bruins B. Positionering academische ziekenhuizen. Den Haag; 2006.