Optimizing cancer care through e-health: status, potential, and adoption

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Citation

Wessels-van Deursen, J. E. (2025, November 18). *Optimizing cancer care through e-health: status, potential, and adoption*. Retrieved from https://hdl.handle.net/1887/4283355

Chapter 7

General discussion

Cancer is a growing global health concern. The number of diagnoses and cancer-related deaths is increasing, but so are the survival rates and healthcare expenditures [1-5]. Several factors contribute to the rising cancer statistics, including an aging population, changes in lifestyle, and advancements in diagnostics [6-8]. As healthcare demands continue to grow and concerns about staff capacity and affordability arise, innovative solutions are necessary [5, 9-12].

The overall aim of this dissertation was to examine how cancer care can be optimized by incorporating e-health technology. This was done through an exploration of three main research questions:

1. What is the current scientific base for e-health interventions for Dutch cancer survivors?
2. What are the perspectives of cancer survivors and healthcare providers on the potential value of e-health in optimizing cancer care?
3. What factors are related to cancer survivors' uptake and adoption of e-health interventions?

In this general discussion, the main findings of this dissertation will be summarized. The main findings will be followed by a reflection on these findings, recommendations for policy and practice, methodological reflections, and future research recommendations.

Main findings

1. What is the current scientific base for e-health interventions for Dutch cancer survivors?

To address this research question, a systematic review was conducted to create an overview of available e-health interventions for cancer survivors in the Netherlands, their characteristics, and the scientific evidence for their impact on population health, quality of care, and per capita costs (**Chapter 2**) [13]. The review identified 38 unique interventions, with half addressing psychosocial issues. Most interventions focused on providing information or supporting self-management, and in more than half (digital) healthcare provider support was included. While some interventions were tailored to specific cancer types or complaints, none were tailored to individual characteristics such as age, gender, or disease severity, highlighting a gap in personalized e-health interventions. Regarding their impact, the interventions contributed to improvements in several health outcomes, including sleep quality, fatigue, and physical activity, consistent with findings from international reviews [14-16]. Mixed effects were observed for certain outcomes, such as psychological complaints and adjustment. No significant impact was found on smoking behaviour, physical health, and health-related quality of life. Additionally, important knowledge gaps remain, particularly in economic evaluations and the accessibility of interventions across different subpopulations.

2. What are the perspectives of cancer survivors and healthcare providers on the potential value of e-health in optimizing cancer care?

Two qualitative studies were conducted to address this second research question. The first study, involving healthcare professionals (i.e., healthcare providers and managers in colorectal cancer (CRC) care), identified improvement opportunities within the CRC care pathway through e-health and explored the potential impact on population health, quality of care, per capita healthcare costs, and staff experiences (**Chapter 3**) [17]. The second study, conducted through focus groups with Dutch CRC survivors, gathered insights into their care experiences, identified improvement areas, and investigated how e-health could optimize CRC care delivery (**Chapter 4**). Both healthcare professionals (HCP) and CRC survivors were generally open to using e-health, though they acknowledged it might not be suitable for all patients. HCPs noted that e-health currently was not yet being utilized to its full potential. Identified opportunities for e-health application spanned various phases of the CRC care pathway, with a primary focus on improving information provision, communication, and health monitoring. Examples included digital intakes to replace traditional in-person pre-colonoscopy intakes - an approach validated as equally effective as nurse-led counselling in other research [18] - , online information services about treatment options, and digital consultation hours. Cancer survivors, in particular, emphasized the need for more information and guidance during the aftercare phase, specifically regarding recovery, coping and mental care, reintegration, nutrition, and physical fitness. Many felt lost and uncertain about what to expect during this phase and multiple survivors would have liked to be better monitored. Both groups emphasized the need for better electronic data exchange among HCP's. Notably, healthcare providers, managers, and cancer survivors had distinct perspectives on e-health in CRC care, each bringing unique insights. Each group proposed unique ideas not raised by the other: HCPs highlighted the potential of e-health to support prehabilitation, advanced care planning, and shared decision-making, while cancer survivors suggested ideas to facilitate peer-to-peer support. Additionally, some survivors expressed reluctance toward e-health, fearing that telemonitoring might be used primarily as a cost-saving measure rather than as a means to improve care quality and patient safety.

3. What factors are related to cancer survivors' uptake and adoption of e-health interventions?

Two studies were conducted to address the final research question of this dissertation, both focusing on a specific form of e-health: digital self-management interventions. The first study used interviews and an online questionnaire to examine what cancer survivors in the aftercare phase need for the uptake and adoption of digital self-management programs. It also examined the role of sociodemographic and clinical characteristics (**Chapter 5**). The second study used the OncoAppstore as a case study [19], aiming to examine the early uptake of the OncoAppstore and explore sociodemographic, clinical, income, and healthcare usage factors associated with its uptake among cancer survivors by comparing users with the general population of cancer survivors (**Chapter 6**).

The findings revealed that, while cancer survivors clearly recognized the value of digital self-management programs for managing cancer- and treatment related challenges, few had actually used them. Three main barriers were identified: 1) lack of awareness and information about the programs, 2) reluctance or inability to pay for them, and 3) the need for evidence-based, personalized content. Survivors also expressed the importance of additional support to use the programs effectively, and they wanted access to HCPs or a coach within the program. Some believed in-person care to be superior. Sociodemographic and clinical variables did not appear to influence the factors needed for uptake and adoption.

The OncoAppstore can help raise awareness of digital self-management interventions as it is a hosted on a well-known Dutch platform for cancer survivors and their relatives (Kanker.nl) and it removes the cost barrier by providing users with a digital health credit of one hundred euros to purchase interventions. Regarding its early uptake, findings revealed that, similar to other studies on e-health usage, the users were a selective group of cancer survivors, primarily individuals with high socioeconomic status, which could potentially widen e-health inequalities. Specifically, OncoAppstore users tended to have higher educational levels and incomes, were more likely to be female, younger on average, and more often of Dutch origin compared to the general population. Additionally, users differed significantly from the general population in terms of healthcare expenditures, with higher general and specialist mental healthcare expenditures and lower pharmaceutical and general practitioner expenditures in the year before diagnosis.

Reflections on the main findings

Our research underscores several key considerations pertinent for exploring the potential of e-health in optimizing cancer care. These reflections will be discussed in this paragraph.

Unlocking the potential of e-health: the importance of stakeholder involvement

This research revealed that, while many e-health interventions are available and generally welcomed by both healthcare professionals and cancer survivors, they are not widely scaled or fully utilized (**Chapters 2–5**). For example, this is evident in the low adoption of digital self-management interventions by cancer survivors (**Chapter 5**), and in healthcare providers' views that e-health remains underused in the CRC care pathway (**Chapters 3**). A key question, therefore, is how e-health can be better utilized and embedded as a structural and valuable component of healthcare delivery to maximize its potential in improving patient care, enhancing efficiency, and supporting healthcare professionals. This aligns with a key objective of the Dutch

Integrated Care Agreement (in Dutch: Integraal Zorgakkoord), which sets agreements between various healthcare stakeholders and the government to enhance quality, accessibility and affordability of the healthcare system and making it future-proof. One central goal is the implementation of hybrid care approaches in 70% of the care pathways, which involves a balanced integration of digital and in-person care [20]. To achieve this, it is crucial to incorporate insights on challenges, needs and prerequisites, from those directly involved in daily care practices - such as cancer survivors, healthcare providers, policy makers and health insurers - ensuring that e-health serves as a tool to improve care rather than an end goal in itself. Our studies highlight the value of involving stakeholders. Healthcare providers, managers, and cancer survivors identified multiple opportunities, primarily aimed at enhancing information provision, communication, and health monitoring, to optimize CRC care pathways through e-health integration (**Chapters 3 and 4**). Additionally, cancer survivors highlighted key barriers to the uptake and adoption of digital self-management programs, revealing important challenges that need to be addressed (**Chapter 5**). Understanding these improvement opportunities and barriers is essential for successfully embedding e-health into routine care. This aligns with other research, which also emphasizes that involving stakeholders and applying principles of co-creation (i.e., inviting relevant stakeholders to express their wants and needs throughout the development and implementation of e-health) leads to user-centered e-health designs that better align with the needs, preferences and skills of end-users, as well as the workflows of healthcare settings [21, 22]. Thus, involving stakeholders increases the chance of acceptance, adoption, and engagement with e-health technologies [21-23]. However, to date, stakeholder involvement in e-health research and development still does not always happen, which is a barrier for successful e-health implementation [24-27].

Navigating complexity in priority setting and implementation of e-health

Although stakeholder involvement is important, it is not the only factor to consider for successful e-health implementation. As previously noted, numerous opportunities to improve the CRC care pathway were identified through exploring stakeholders' perspectives (**Chapters 3 and 4**). This is an important first step, but there are still some fundamental questions that remain unanswered: How should these improvement opportunities be prioritized, and should all ideas be implemented? Additionally, how can successful implementation be facilitated? As outlined in the introduction of this dissertation, many e-health interventions fail during clinical implementation [23, 28-30]. The Non-adoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability (NASSS) framework, which focuses on healthcare innovation implementation, outlines seven domains that help clarify the complexity of the implementation process: the e-health technology (i.e., evidence strength and quality), the disease or condition, the users (i.e., ability and willingness to use the intervention), the value of the e-health interventions for stakeholders, the inner setting (i.e., implementation climate), and the outer setting (i.e., national policy and political, economic and professional environment) along with a seventh domain that considers how all of these domains evolve over time [29-34].

While the added value of e-health for stakeholders, as assessed in our studies, is one of the crucial aspects, the NASSS framework highlights that one should have a broader view for the successful implementation of e-health interventions in the cancer care pathway. One should consider all seven domains when thinking about the adequate prioritization and implementation of e-health innovation in general and, more specifically, the identified opportunities for e-health to improve cancer care in daily practice. The ideas and wishes of the stakeholders as outlined in Chapter 3 and 4 should be further investigated and prioritized by, among other things, looking at the local contexts and the required technology.

Increasing awareness of the availability of evidence-based digital aftercare programs

Focusing on the aftercare phase of the cancer care pathway, this research highlights that survivors face many challenges and complaints after treatment, for which they seek support (**Chapters 4 and 5**). They also express a strong interest in using e-health interventions to address these issues and to receive additional guidance on topics such as fatigue, fear of cancer recurrence, pain, emotional processing, nutrition, and physical activity (**Chapters 4 and 5**). While various e-health interventions exist (**Chapter 2**), their usage remains low. A key barrier, at least for the uptake and adoption of digital self-management programs, is the lack of awareness among stakeholders about their availability and potential benefits (**Chapter 5**). This raises an important question: Who is responsible for raising awareness? The answer lies in a shared responsibility of various parties, including healthcare providers, government agencies, and healthcare insurers. Effective collaboration among these stakeholders is essential to ensure consistent and accessible guidance for cancer survivors. Importantly, these parties should be informed about the available supply of evidence-based e-health interventions. This may help, for example, practitioners, who often need help deciding which applications to recommend to their patients [35]. Initiatives such as the OncoAppstore can support these parties and help to increase awareness of the existence of reliable digital (aftercare) self-management interventions. Another way to increase awareness could be by creating a link between the programs, and websites such as Thuisarts.nl, a Dutch website with reliable information on health and diseases developed by healthcare providers [36]. However, there is also a role for the end user; they should take ownership to actively explore available options.

Besides awareness of the existence of cancer-related e-health interventions, it is crucial that stakeholders -especially cancer survivors- can trust that e-health interventions are evidence-based. Survivors seek programs backed by sufficient evidence of effectiveness and safety (**Chapters 4 and 5**). While some e-health interventions have been evaluated and shown to be effective

(**Chapter 2**), a significant evidence gap remains, as many interventions have yet to be (scientifically) studied for their impact [37]. The ISO 82304-2 has been developed as an international quality standard for health applications, which could help stakeholders separate reliable interventions from less reliable ones [38, 39]. By establishing criteria and using standards to assess the effectiveness and suitability of interventions, stakeholders can make informed decisions about which digital aftercare programs are most beneficial for cancer survivors.

Implications for policy and practice

The findings of this dissertation hold significant implications for policy development and practical implementation in the field of healthcare to enhance patient outcomes and healthcare delivery ultimately. These will be discussed below.

Balancing healthcare efficiency and accessibility: addressing the digital divide

As previously noted, raising awareness about the existence and potential benefits of e-health interventions is essential to ensuring that cancer survivors have the opportunity to use them. However, awareness alone is not sufficient - survivors must also have the capability to engage with the technologies. While many survivors indicate they possess enough digital skills to use digital self-management programs, almost half of them indicated they needed further assistance to use them (**Chapter 5**). Additionally, both healthcare professionals and survivors in our research believed that e-health is not suitable for every patient (**Chapters 3 – 5**). These findings align with broader research showing that e-health is predominantly used by younger, highly educated individuals with high incomes, reflecting the digital divide; the gap between those who have access to and can effectively use digital technologies and those who cannot [40-54]. Older age, lower education, and lower income are associated with lower digital literacy, which represents a significant barrier to the adoption of e-health solutions [47, 55]. This pattern is also reflected in our study of the OncoAppstore, where early users tended to have higher educational levels and incomes, were more likely to be female, younger on average, and more often of Dutch origin compared to the general population of cancer survivors (**Chapter 6**). Still, the OncoAppstore was not specifically designed to reach all potential users. Its primary aim is to enhance and simplify access to evidence-based self-management interventions for cancer survivors who may benefit from them.

E-health can help reduce pressure on formal healthcare by serving those who are already easily reached and willing to use digital solutions, potentially freeing up capacity for others who are less inclined or able to engage with these technologies. However, e-health does not merely replace existing care but also provides services that are often lacking in traditional healthcare, such as access to personal health data or tailored information. While this can enhance self-management and overall health, it may also widen health disparities if certain groups face barriers to accessing digital resources. Those who struggle with digital tools risk having less access to care rather than benefiting from greater efficiency. Addressing this challenge requires targeted efforts to improve accessibility and support individuals with limited digital literacy, reinforcing the need for digital inclusivity strategies such as those highlighted in the eHealth4All project [56]. Furthermore, improving digital skills among both healthcare providers and cancer survivors is crucial in this regard. Offering training programs customized to individuals' skill levels and needs, easy-to-use interfaces, and accessible support channels can help individuals to confidently engage with e-health technologies [57]. An initiative that could assist individuals in learning to work with e-health is the 'Digivitaler' program by the 'Digisterker' foundation, a part of Dutch public libraries' digital educative initiatives [58]. The program is designed to help individuals become familiar with e-health and learn how to work with it. Also, in the Netherlands, healthcare institutions could apply for grants to train 'digicoaches', who are healthcare employees with digital expertise, to assist and train their colleagues [59]. Furthermore, the website digivaardigindezorg.nl supports healthcare professionals and patients who want to improve their digital skills to access e-health services [59].

Addressing the allocation of financial responsibility for digital self-management programs

This dissertation underscores the necessity of reimbursing digital self-management interventions for cancer survivors to encourage their uptake and adoption, as financial constraints have been a significant barrier (**Chapter 5**). Illustratively, there is no structural funding mechanism, and in turn no reimbursement schemes for platforms like the OncoAppstore are in place (**Chapter 6**). In the Netherlands, the financing of e-health technology remains a disputed issue. Without clear delineation of financial responsibility (i.e. which payer should pay for these digital self-management programs), reimbursement for these programs will remain challenging. The fundamental challenge lies in the classification of these digital self-management programs, so whether these programs are codified as a form of collective prevention, as non-medical services, or as reimbursed care under the Health Insurance Act. This codification is crucial as it determines the responsible funding entity.

When codified as collective prevention they fall under the Public Health Act, which would make municipalities responsible for funding [60]. Conversely, if these programs are considered as non-medical services, like fitness apps, the cost burden would shift to individual consumers or parties like employers. Development and research on effectiveness should in this case be paid by the private market. Another option is to classify them as reimbursed care under the Health Insurance Act, making health insurers responsible for funding [61]. The National Health Care Institute (in Dutch: Zorginstituut Nederland, ZiN) assesses whether an intervention qualifies as reimbursed care based on several criteria derived from the Health Insurance Act (Zvw). Two main criteria are: state of the science and practice (proven effective and safe according to research and practical experience) and standard practice (care that is part of the regular offering within the professional group and provided according to professional standards) [62]. To date, ZiN has not provided clarity on whether digital self-management programs for cancer survivors fall under insured care. However, the Dutch Healthcare Authority (Dutch abbreviation: NZa) aims to promote 'appropriate e-health' as an integral part of the care services, advocating that e-health programs can be considered as care under the Health Insurance act [63]. The NZa focuses on developing a flexible reimbursement structure to enable healthcare providers to implement digital solutions [63]. The NZa has simplified regulations for digital consultations and placed an increased focus on technologies that enhance healthcare capacity, such as telemonitoring, which our research showed could be valuable technology to enhance the CRC pathway (**Chapters 3 and 4**) [63]. However, the scope of services encompassed within the broader definition of 'e-health' remains unclear, particularly for digital applications that fall outside the conventional medical treatment relationship between HCP's and patients, such as self-management programs in the aftercare phase [63, 64].

Our research findings indicate that cancer survivors often expect health insurer to reimburse digital self-management programs (**Chapters 4 and 5**). Two potential directions for the reimbursement of digital self-management programs under the Health Insurance Act are worth further investigation. First, since 2021, an 'optional performance' (in Dutch: 'facultatieve prestatie') has been introduced in specialized medical care, allowing healthcare providers and insurers to negotiate contractual agreements for services and activities that do not fit within regular reimbursement structures including digital healthcare solutions [63]. This possibility has already been used in mental healthcare to integrate digital apps into treatment pathways and could potentially also be applied to digital self-management programs for cancer survivors. Second, the NZa's Innovation Policy Rule for Small-Scale Experiments provides an opportunity to experiment with innovative healthcare solutions for up to three years, with the possibility of a two-year extension. If successful, these interventions may be integrated into the standard reimbursement system [63]. This policy rule could be valuable for exploring whether digital self-management programs, or platforms like the OncoAppstore (**Chapter 6**), are effective in reaching their goals and so strengthening the empirical base for why they should (or not) become part of regular care as assessed by ZiN.

Healthcare providers and insurers could collaborate to explore these options and determine the most appropriate way to fund and integrate these programs into the healthcare system. However, both options do not fully address the underlying issues related to the allocation of financial responsibility for digital aftercare programs, policy classification, and decision-making. ZiN should provide guidance on these matters, with the possibility for adjustments to be made by the Dutch government regarding which types of care falls under the Healthcare Insurance Law.

Stimulate mutual learning and cooperation for successful implementation and innovation

This research has identified several valuable opportunities for improving CRC care through e-health (**Chapters 2 and 3**), while also highlighting variations in how and to what extent key stakeholders currently utilize e-health across the care pathway. For example, some healthcare professionals already use digital intakes before colonoscopies, while others do not (**Chapter 3**). Given the large potential of e-health and the differences observed, it is essential for stakeholders involved in e-health development and implementation to prioritize mutual learning and effective collaboration. This would also be beneficial in exploring appropriate funding structures for, for example, digital self-management programs (**Chapters 5 and 6**). While acknowledging the challenges associated with this endeavor, it is crucial to avoid redundant efforts by organizations reinventing the wheel independently. This can be addressed both by healthcare professionals themselves and by health insurers and government agencies, as illustrated by the following examples.

An initiative where healthcare organizations collaborate on realizing innovation is 'Working Differently in Healthcare' (In Dutch: Anders Werken in de Zorg) [65]. This foundation advocates for innovative approaches to healthcare delivery, emphasizing collaboration, efficiency, and patient-centric care. The objective is to expedite innovation in healthcare, with a dual focus on regional collaboration and support from national organizations or supra-regional coordination [65]. The foundation conducts small-scale tests within several healthcare organizations, accompanied by evaluations. Upon achieving positive results, these successful innovations are scaled up. In doing so, they leverage each other's experiences intelligently [65]. Furthermore, 'Digizo.nu' is an example of a valuable platform initiated by the signatories of the Integral Care Agreement, including healthcare insurers and the Dutch Ministry of Health, Welfare and Sport [66]. It prioritizes, tests, and evaluates digital applications within transformed processes to help scale these processes [66]. In 2024, a consortium of various parties launched an independent value-assessment initiative, which is currently part of Digizo.nu [67]. More than twenty knowledge institutions conduct practice-oriented research on the use of digital technological tools in the healthcare sector, aiming to collect data in a standardized format to enable data consolidation and facilitate comparative analysis.

Moreover, the national government can facilitate collaboration between relevant stakeholders. For example, the government can play a crucial role in enhancing data exchange- an issue both healthcare providers and cancer survivors have identified as currently suboptimal (**Chapters 2 and 3**). The Dutch Taskforce Cancer Survivorship Care indicates that continuity and coordinated cohesion in cancer care are essential starting points along with increased cooperation within and between the care chain. The Taskforce stresses that data exchange plays a vital role in improving cooperation [68]. In response, the Dutch Ministry of Health, Welfare and Sport has allocated funding to promote data exchange. Also, the CumuluZ Coalition, an agency of VWS, is working to create a single, secure, national, and standardized public data infrastructure for healthcare [69].

Methodological strengths and limitations

The dissertation has several notable strengths. By employing multiple research methods - including literature review, qualitative, and quantitative analyses - it enhances both the depth and breadth of its findings. Additionally, this research adopts a multi-perspective approach, integrating the viewpoints of cancer survivors and healthcare providers while collaborating with leading organizations in the field of cancer care. For example, in partnership with IKNL, e-health interventions were examined in a real-world setting through the study of the OncoAppstore. This diversity of perspectives has allowed us to uncover concrete insights into the practical challenges and opportunities of implementing e-health technologies in cancer care.

The dissertation also has some limitations that should be considered. There is a possibility of selection bias across several studies. Participants may have leaned towards those positively inclined towards e-health usage and those with higher digital literacy. Consequently, our results may overestimate the acceptance and effectiveness of digital self-management interventions. Also, the challenges and barriers faced by cancer survivors with lower digital skills, or a more skeptical view of e-health might not have been fully captured. Additionally, our chosen focus in several studies may have affected the generalizability of the findings. For instance, we prioritized a specific cancer type (colorectal cancer) and a particular phase of the care pathway (post-treatment or aftercare). Findings could be different for other types of cancer or phases of the healthcare process. Chapters 3 and 4, furthermore, focus on specific care settings, namely hospital care and specialized healthcare providers. Although these studies provide valuable insights into hospital-based aspects of cancer care, they overlook the crucial role of primary care providers, such as general practitioners and physiotherapists, and the interplay between healthcare providers from different settings. Including other care providers in these studies would improve the findings by offering a more comprehensive understanding and approach to care coordination throughout the entire cancer care continuum. However, these choices were made because the field of cancer care is extensive, encompassing a diverse patient population, various treatment methods, and survival rates. By focusing on a specific cancer type, care phase, and care setting, we were able to dive deeper into the unique challenges and needs within this context, providing more targeted insights that could inform improvements.

Recommendations for future research

More research on optimizing cancer care through e-health should focus on the integration of e-health in cancer care pathways. Specifically, further research can be conducted to assess which ideas for improving the cancer care pathway, as suggested by the cancer survivors, healthcare providers, and managers involved in the studies of this dissertation, are feasible. Additionally, research should explore how these ideas can be best prioritized and implemented. Studies should explore facilitators and barriers to implementation using frameworks such as NASSS and investigate strategies to ensure successful adoption and scaling.

Furthermore, future studies should explore effective strategies to increase awareness of existing evidence-based e-health interventions, particularly digital self-management tools, among cancer survivors, healthcare professionals, and policy makers. Building upon the findings gathered using the COM-B model, the Behavioural Change Wheel could be used to further explore these intervention strategies [70]. Research should, for example, examine how different communication channels (e.g., healthcare professionals' recommendations, online platforms, or patient organizations) influence awareness and uptake and adoption rates.

Also, the current dissertation showed that there is a lack of personalized digital programs tailored to individual characteristics (e.g., age, gender, disease severity) and needs (**Chapter 2**), while patients prefer programs tailored to their personal situation (**Chapters 4 and 5**). Future research should examine how digital self-management interventions can be effectively personalized and explore how such personalization affects engagement, effectiveness, and patient outcomes. In doing so, future studies should involve end-users (cancer survivors, healthcare providers, policymakers) through co-creation methodologies. This can help ensure interventions meet user needs, increasing uptake and adoption.

Moreover, given the current ambiguity surrounding the funding of digital self-management programs, future research should focus on identifying sustainable reimbursement models for these interventions. Comprehensive economic evaluations and cost-benefit analyses are needed to assess their financial viability, particularly in relation to the criteria for reimbursed care under the Healthcare Insurance Act as evaluated by ZiN. While some studies have explored cost-effectiveness (**Chapter 1**), the evidence remains limited and inconclusive. In line with ZiN's substitution principle - indicating that e-health should replace or supplement traditional care without compromising quality - it is crucial to investigate which components of digital self-management programs may meet this criterion and how. Prior research has also highlighted the lack of evidence comparing digital technologies to usual care [71, 72]. Evaluations should consider both direct costs, such as healthcare utilization, and indirect costs, such as travel expenses and sickness absence. Additionally, future research should explore how to design, implement, and evaluate sustainable payment methods for e-health.

Researchers should also investigate strategies to reach underrepresented groups, such as cancer survivors with lower socioeconomic status or those of non-Dutch origin, as knowledge on how to engage these populations is still limited [73, 74]. Future research should also explore how e-health interventions can be made more inclusive, especially for populations with lower digital literacy or those from lower socioeconomic backgrounds. Research could focus on developing strategies to reduce the digital divide and evaluate the effectiveness of these strategies in improving access to e-health interventions for cancer survivors.

Finally, conducting comparative research in different contexts is crucial for understanding the effectiveness and applicability of e-health interventions in cancer care. Researchers can evaluate similarities and differences in outcomes, identify best practices, and examine the effects of various cultural, social, and healthcare contexts by replicating current studies in different countries or healthcare systems. Furthermore, comparing outcomes for different cancer types can provide valuable insights into the effectiveness of e-health interventions across various disease trajectories and patient populations, which can help develop personalized approaches to e-health in cancer care.

Conclusion

This dissertation aimed to explore how cancer care in the Netherlands could be optimized by incorporating e-health technologies, with the goal of enhancing patient outcomes and improving healthcare delivery. Through an in-depth examination of current state of e-health interventions, exploring the perspectives of cancer survivors and healthcare providers, and examining the factors related to the uptake and adoption of digital self-management programs, the dissertation highlighted both the opportunities and challenges in this evolving field. The findings underscore the potential of e-health in cancer care, while also identifying the barriers that need to be addressed to ensure effective implementation. Ultimately, this dissertation offered valuable insights and recommendations for optimizing cancer care through e-health, aiming to contribute to improved patient outcomes, optimized healthcare services, and the continued evolution of cancer care in the Netherlands and beyond.

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