Original Article

Changes in Technical Equipment and Patient Perspectives Navigating Towards Enhanced Digitalization in Breast Cancer Across Pre-COVID-19 and Early COVID-19 Eras

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Abstract

This study investigates the readiness of breast cancer patients for eHealth, examining their technical equipment and attitudes towards digital therapy support. Surveys conducted in 2013, 2016, and 2020 with 959 patients reveal a significant increase in internet access, device ownership, and a shift from neutral to positive attitudes towards eHealth. These findings suggest that key prerequisites for integrating digital therapy in routine care are increasingly being met.

Introduction: The potential benefits of eHealth support in enhancing patient care, satisfaction, and cancer outcomes are well-established; however, its integration into routine care has been gradual. The emergence of the COVID-19 pandemic in 2020 dramatically affected cancer patients, imposing multifaceted challenges that impede traditional doctor-patient interactions. Consequently, there has been a surge in the adoption of eHealth for supporting oncological therapies. This study investigates the fundamental prerequisites for transitioning to a more digitally oriented routine care, focusing on the availability of appropriate technical equipment and the cultivation of a positive mindset towards eHealth among breast cancer patients. **Patients and Methods:** In 2013, 2016, and 2020, breast cancer patients participated in surveys utilizing a comprehensive paper questionnaire encompassing 29 inquiries about their health status, technical equipment, and attitudes toward digital therapy support. **Results:** A total of 959 patients participated in the interviews. Comparative analyses between the 2013, 2016, and 2020 surveys revealed a widespread increase in internet access and device ownership across various age groups. By 2020, 3 quarters of patients were utilizing the internet for health-related topics. Notably, there has been a considerable improvement in patients' personal attitudes towards eHealth and their expectations for future digital therapy support. **Discussion:** Over the seven years spanned by the surveys, there has been a substantial positive shift in the attitudes of breast cancer patients towards eHealth, accompanied by a marked improvement in their technical equipment. This study reveals that the essential prerequisites for digital therapy support now appear to be prevalent among breast cancer patients.

Clinical Breast Cancer, Vol. 24, No. 8, e690–e700
Keywords: eHealth, ePRO, mHealth, Patient's satisfaction, Digital therapy support

Introduction

Since 2020, worldwide healthcare systems have been confronted with unexpected new challenges due to the COVID-19 pandemic. As of November 2020, about 50 million confirmed cases and more than 1.2 million deaths related to COVID-19 have been reported globally.[1] Infectious diseases such as COVID-19 require social distancing and self-isolation to prevent and reduce infection rates in all sectors. Patient safety and resource availability concerns have led to restrictions on interpersonal medical consultations and postponement of surgical and routine procedures in 2020. Using predictive modelling, it was estimated that in the peak twelve weeks

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Submitted: Mar 23, 2024; Revised: Jul 12, 2024; Accepted: Aug 4, 2024; Epub: 6 August 2024

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https://doi.org/10.1016/j.clbc.2024.08.004

of disruption due to COVID-19 alone, over 28 million surgeries were postponed.[2]

Cancer patients particularly suffer from delays in diagnosis and treatment, as early detection and diagnosis are often critical to the disease's course. A 4-week delay in surgery is already associated with an increased mortality rate for many types of cancer such as breast cancer.[3] A substantial increase in avoidable cancer deaths is expected to be caused by the COVID-19, particularly because of the limitation of routine diagnostics.[4] For different subgroups such as patients with ER+ HER2− primary breast cancer, separate guidelines have been developed to manage their treatment despite postponed surgeries caused by COVID-19.[5] Several studies have shown that cancer patients also have a higher risk of severe complications and a worse outcome for severe acute respiratory syndrome after infection with the coronavirus.[6-8] Nevertheless, COVID-19 can also be asymptomatic or subclinical and managed at home.[9]

In recent years, developments in information and telecommunication technology have underscored its role as key technology, shaping the presence and defining challenges and opportunities across almost all areas. This progress is also strongly reflected in the healthcare sector. Although most of these concepts are generally referred to as eHealth, this term has not yet been clearly defined, and a variety of definitions and delimitations exist.[10] One very common definition by Eysenbach et al.[11] Describes eHealth as "health services and information delivered or enhanced through the internet and related technologies"

The scope of eHealth encompasses a wide range. It includes basic information retrieval and communication, such as accessing educational materials online,[12] as well as the use of electronic patient records (EPRs) and patient accessible electronic health records (PAEHRs) for sharing patient information among healthcare providers and patients.[13,14] Additionally, it covers electronic prescriptions for efficient medication management.[15] At the advanced end, eHealth includes personalized digital therapies using real-time (electronic) patient-reported outcomes ([e]PROs) for managing treatment side effects in breast cancer patients.[16] It also encompasses developments in artificial intelligence (AI)-driven diagnostic tools for early detection of breast cancer through the analysis of imaging data.[17]

Numerous papers on different existing technologies have already been published, and it is now widely recognized that major unused opportunities regarding eHealth technologies exist. In a recently published review, Konttila et al.[18] state that knowledge and skills in digital technology can improve patient care. Basch et al.[19] illustrate that eHealth support of cancer patients leads to significantly higher patient satisfaction, longer therapy duration, fewer emergencies, and longer overall survival compared to cancer patients receiving conventional care. Similarly, Denis et al.[20] provide empirical evidence showing increased overall survival in lung cancer patients by performing web-application-based follow-up. Dayer et al.[21] propose using smartphone apps as a possible eHealth service solution with tailored information, offering tools for communication and monitoring. Thus, eHealth and most concretely ePROs as the source of valuable information for improved therapy management have become more and more helpful, mainly because the patient is actively involved in therapy management.[22] This is particularly relevant in routine care, where there is often poor concordance between physician-reported and patient-reported side effects, partly due to previous collection methods being a significant barrier.[23]

The immediate opportunities of eHealth support may vary depending on the clinical setting. In oncology, the increasing use of oral antineoplastic therapy brings about fundamental changes during therapy for patients and physicians. Most patients prefer oral cancer therapy over intravenous (iv) therapy because it is more convenient, eliminates the need for freqeuent visits to the doctor, and gives patients more control over their therapy.[24] While quality of life can often be significantly improved in an outpatient setting,[25] issues such as lack of adherence create a substantial problem in the management of oral therapies[26,27] and may even affect mortality.[28]

During the COVID-19 pandemic, telemedicine has shown that many outpatient visits can be clinically managed effectively from a distance without affecting patient health,[29] thus addressing one of the greatest challenges of the pandemic for cancer patients. Numerous recent publications suggest telemedicine, including web-based consultations and other application scenarios, as a solution for patient management and maintaining an intact healthcare infrastructure during the pandemic.[30-35] The large number of concepts created in a short time frame clearly demonstrate the important role that eHealth instruments can play internationally across the different medical disciplines, simply driven by the need to provide continued medical care in the era of social distancing. The impact of the COVID-19 pandemic seems to offer the opportunity for rapid implementation of digital support in medicine, particularly aimed at disease monitoring and therapy support. However, there are still several challenges in the implementation process, such as the integration of telemedicine into international and national health guidelines.[32]

All concepts for the use of eHealth in routine care demand multiple basic requirements. For example, the necessary technical infrastructure must be available, and acceptance—especially in the sense of a positive mindset—must be present in all stakeholders such as medical personnel and patients. It is essential for healthcare professionals to perceive a benefit from using a new technology in order to improve therapy.[18] Besides, prior IT experience and the intention to use a system also play an important role in predicting the use of health IT as part of routine patient treatment.[36]

In a previous study, we investigated readiness and availability of the necessary infrastructure regarding breast cancer patients' eHealth therapy support among treating physicians.[37] We aimed to address whether breast cancer patients of different ages, performance statuses, and educational backgrounds are prepared to move to more digitalized healthcare, and whether there is basic acceptance and a need for further practice-orientated solutions, appropriate education, and training.[29,38,39] Given the dramatic impact of the COVID-19 pandemic on routine breast cancer care, the timing of our interviews is clinically significant.

Materials and Methods

Surveys were conducted at three 3 points on randomly selected patients diagnosed with breast cancer. The first data collection took place from 2012 to 2013, the second from 2015 to 2016,

and the third in 2020. The paper-pencil-based German-language survey was distributed at 4 different outpatient clinics and at three patient breast cancer information events hosted by the Ludwig-Maximilians-University (LMU) Breast Center in Munich, Germany. The treating doctors invited their consecutive patients to voluntarily answer the questionnaire once during their therapy. The only criterion for inclusion was a current or past breast cancer diagnosis. The survey was conducted anonymously and without providing any incentives to the participants. The questionnaire was originally designed with assistance from "Mamazone" and "Brustkrebs Deutschland," 2 large German breast cancer advocacy groups, and approved by the ethics committee of the LMU medical faculty.[40] The questionnaire remained unchanged between the 3 time points for reasons of comparability. It contained 27 single- and multiple-choice questions as well as 2 numerical questions summarized in 4 question groups.

Structure of the Questionnaire

In the first group, the patients were asked about their living and professional situation. In addition to gender, age, and educational background, the recorded data include the number of people or patients living with them, the population size of their residence area, and their employment status.

The second group included questions on the general health state according to the Eastern Cooperative Oncology Group (ECOG) performance status scale ranging from "fully active" (0) to "completely disabled" (4).[41] The aim of this classification is to describe the ability to perform daily activities and the related level of assistance required. In addition, data on breast cancer was collected, such as the time of initial diagnosis, metastasis status and therapy history.

The third group included questions about the patients' ownership of internet-capable devices, like certain phone types, tablets, and personal computers, as well as their current internet usage behavior. Three device groups were created: PC, tablet PC, and smartphone. First, patients were asked about the tasks for which they used the internet and how often they performed these tasks, such as writing emails, making internet/video telephone calls, purchasing goods/services, or online banking. Second, detailed questions were asked about their usage behavior concerning health-related topics. Patients were also asked whether they needed help in this regard and what their specific intent was, eg, searching for information about their disease, looking up practitioners, or establishing contact with their doctor or pharmacist.

The last group of questions focused on patients' personal opinions and wishes for future use of internet and communication technologies in the context of therapy support for their cancer. Questions concerning personal opinions were rated on a 5-point scale ranging from +2 "very high acceptance" over 0 being neutral to -2 "very low acceptance." General questions were asked, such as whether patients could imagine using therapy support via the internet or smartphone, as well as their attitudes towards concrete scenarios such as documentation of side effects via smartphone or using an independent phone hotline.

The most recent survey was conducted in March 2020, shortly before the first peak of the COVID-19 pandemic in Europe and about 2 weeks before lockdown restrictions were enforced in Germany. For evaluation of the questions on current and future usage behavior, the surveys in 2013-2016 were therefore combined into one group to differentiate them from the survey during the pandemic.

Statistical Analysis

Data analysis was performed using SPSS version 26. Descriptive statistics summarized demographic and baseline characteristics of participants. The Kruskal-Wallis test was utilized to compare nonparametric data across the three survey time points (2013, 2016, 2020). Spearman's rank correlation coefficient was employed to assess relationships between the specific questions. Differences with a P value $< .05$ were considered significant in all tests.

Results

A total of 959 individuals were surveyed, with 190 excluded due to not being diagnosed with breast cancer. The final cohort comprised 769 participants, including 321 patients from 2013, 211 patients from 2016, and 237 patients from 2020.

Patient Sociodemographic and Baseline Health Characteristics

The respondents had a median age of 59 years in 2013, which decreased to 56 years in both 2016-2020. Across all surveys, participants' ages ranged from 23 to 89 years, with women comprising 99.5% of the cohort. A total of 49.0% of respondents completed their school education with the German Abitur or higher, equivalent to an international high school graduation. This percentage was 42.4% in 2013, 53.6% in 2016, and 54.0% in 2020. Overall, the level of education increased significantly ($P < .011$) from 2013 to 2016 and remained at the same level in 2020.

In terms of living arrangements, 26.3% of patients lived alone while 67.8% stated that they lived with at least one other person. The proportion of respondents residing in a city with at least 100,000 inhabitants was 38.6% in 2013, 42.2% in 2016, and 49.4% in 2020.

On the ECOG scale ranging from 0 to 4, 89.7% of patients reported a value of 0 or 1 in 2013. This percentage decreased to 86.7% in 2016 and 78.1% in 2020, indicating a lower ability of respondents to perform daily activities in the more recent surveys.

Among those surveyed, 43.8% were diagnosed with breast cancer within the last year: 38.0% in 2013, 52.6% in 2016, and 43.9% in 2020. Additionally, the percentage of patients with metastases increased from 25.9% in 2013 to 28.9% in 2016 and 38.0% in 2020.

At the time of the survey, most patients had undergone surgery (76.2%), radiation therapy (58.0%), and intravenous chemotherapy (54.4%). The number of patients on antibody therapy more than doubled from 2013 to 2020, increasing from 13.1% to 31.2%, while the proportion on oral chemotherapy more than tripled from 6.2% to 21.5% (Table 1).

Patient Access to the Internet and Ownership of Devices

The possession of internet-capable devices in the PC ($P < .001$), tablet PC ($P < .001$), and smartphone ($P < .001$) categories,

Table 1 Demographics in Comparison Across the Three Surveys and in Total

		Total		2013		2016		2020	
		N	% In Column	*N*	% In Column	*N*	% In Column	*N*	% In Column
Age	<30	11	1.4%	3	0.9%	4	1.9%	4	1.7%
	31-40	79	10.3%	23	7.2%	25	11.8%	31	13.1%
	41-50	162	21.1%	69	21.5%	46	21.8%	47	19.8%
	51-60	170	22.1%	63	19.6%	47	22.3%	60	25.3%
	61-70	184	23.9%	95	29.6%	49	23.2%	40	16.9%
	71-80	111	14.4%	42	13.1%	30	14.2%	39	16.5%
	>80	14	1.8%	2	0.6%	6	2.8%	6	2.5%
	Missing	38	4.9%	24	7.5%	4	1.9%	10	4.2%
Sex	Female	765	99.5%	318	99.1%	211	100.0%	236	99.6%
	Male	1	0.1%	0	0.0%	0	0.0%	1	0.4%
	Missing	3	0.4%	3	0.9%	0	0.0%	0	0.0%
Educational background	Secondary School	123	16.0%	56	17.4%	29	13.7%	38	16.0%
	College	251	32.6%	120	37.4%	65	30.8%	66	27.8%
	High School	134	17.4%	54	16.8%	37	17.5%	43	18.1%
	University	206	26.8%	70	21.8%	66	31.3%	70	29.5%
	Doctoral Degree	37	4.8%	12	3.7%	10	4.7%	15	6.3%
	Missing	18	2.3%	9	2.8%	4	1.9%	5	2.1%
Employment	Employed	301	39.1%	114	35.5%	77	36.5%	110	46.4%
	Official	55	7.2%	18	5.6%	22	10.4%	15	6.3%
	Self-employed	65	8.5%	21	6.5%	25	11.8%	19	8.0%
	Retired	300	39.0%	147	45.8%	74	35.1%	79	33.3%
	Unemployed	24	3.1%	8	2.5%	9	4.3%	7	3.0%
	Missing	24	3.1%	13	4.0%	4	1.9%	7	3.0%
People in household	1	202	26.3%	85	26.5%	51	24.2%	66	27.8%
	2	300	39.0%	138	43.0%	78	37.0%	84	35.4%
	3	101	13.1%	38	11.8%	32	15.2%	31	13.1%
	4	92	12.0%	27	8.4%	33	15.6%	32	13.5%
	5 and more	28	3.6%	10	3.1%	6	2.9%	12	5.1%
	Missing	46	6.0%	23	7.2%	11	5.2%	12	5.1%
Residents in area	<1000	22	2.9%	12	3.7%	3	1.4%	7	3.0%
	1000-9999	118	15.3%	59	18.4%	36	17.1%	23	9.7%
	10,000-49,999	207	26.9%	91	28.3%	62	29.4%	54	22.8%
	50,000-99,999	22	2.9%	10	3.1%	3	1.4%	9	3.8%
	100,000 and more	330	42.9%	124	38.6%	89	42.2%	117	49.4%
	Missing	70	9.1%	25	7.8%	18	8.5%	27	11.4%
ECOG	0	457	59.4%	202	62.9%	136	64.5%	119	50.2%
	1	199	25.9%	86	26.8%	47	22.3%	66	27.8%
	2	74	9.6%	24	7.5%	18	8.5%	32	13.5%
	3	24	3.1%	4	1.2%	6	2.8%	14	5.9%
	4	2	0.3%	0	0.0%	1	0.5%	1	0.4%
	Missing	13	1.7%	5	1.6%	3	1.4%	5	2.1%
Primary diagnosis	Last month	131	17.0%	50	15.6%	50	23.7%	31	13.1%
	Last year	206	26.8%	72	22.4%	61	28.9%	73	30.8%
	1-5 years ago	210	27.3%	81	25.2%	53	25.1%	76	32.1%
	>5 years ago	220	28.6%	116	36.1%	47	22.3%	57	24.1%
	Missing	2	0.3%	2	0.6%	0	0.0%	0	0.0%

(*continued on next page*)

Table 1 (*continued*)

		Total		2013		2016		2020	
		N	% In Column	*N*	% In Column	*N*	% In Column	*N*	% In Column
Metastasis	No	474	61.6%	200	62.3%	135	64.0%	139	58.6%
	Yes	234	30.4%	83	25.9%	61	28.9%	90	38.0%
	Missing	61	7.9%	38	11.8%	15	7.1%	8	3.4%
Surgery	Yes	586	76.2%	262	81.6%	141	66.8%	183	77.2%
Radiation therapy	Yes	446	58.0%	186	57.9%	108	51.2%	152	64.1%
Chemotherapy (iv)	Yes	418	54.4%	165	51.4%	102	48.3%	151	63.7%
Chemotherapy (po)	Yes	81	10.5%	20	6.2%	10	4.7%	51	21.5%
Antihormonal therapy	Yes	316	41.1%	122	38.0%	89	42.2%	105	44.3%
Antibody therapy	Yes	151	19.6%	42	13.1%	35	16.6%	74	31.2%
Further therapies	Yes	51	6.6%	17	5.3%	17	8.1%	17	7.2%
Diagnosed with other cancer	No	698	90.8%	290	90.3%	193	91.5%	215	90.7%
	Yes	55	7.2%	22	6.9%	15	7.1%	18	7.6%
	Missing	16	2.1%	9	2.8%	3	1.4%	4	1.7%
Postmenopausal status	No	260	33.8%	98	30.5%	89	42.2%	73	30.8%
	Yes	486	63.2%	210	65.4%	118	55.9%	158	66.7%
	Missing	23	3.0%	13	4.0%	4	1.9%	6	2.5%

Parameters are presented in both total numbers and percentages.

as well as regular internet access ($P < .001$), exhibited a notable dependence on the age of respondents, declining with advancing age. In 2013, all patients up to the age of 40 had internet access, extending to 50 years in 2016-2020. In 2020, 84.6% of respondents in the second-highest age group (71-80 years) reported regular internet access. In comparison to the 2013 survey, both the 2016-2020 surveys revealed increased internet access and device ownership across almost all age groups, illustrated in Figure 1.

Within the PC group, in all 3 surveys at least 85.7% of patients up to the age of 60 owned a PC. The age group of 61-70 years showed the most significant increase, rising by more than 30%-54.7% in 2013 to 85.0% in 2020. While all respondents in the 31-40 age group stated PC ownership in 2013, this percentage slightly decreased to 92.0% in 2016 and 93.5% in 2020.

Among the devices, smartphone ownership experienced the most substantial increase between surveys. In 2013, 25.6% of respondents owned a smartphone. This rate surged to 59.4% in 2016 and more than tripled to 84.6% in 2020. In the age group of patients over 70, no patient reported owning a smartphone in 2013. By 2016, the proportion reached 19.4%, and in 2020, it further increased to 71.1% of respondents.

The group of patients owning a tablet PC almost tripled from 10.8% in 2013 to 31.4% in 2016, with a subsequent 3.8% increase from 2016 to 2020, totaling 35.2%. The largest ownership of tablet PCs was observed in the 31-40 age group.

As the age of patients in the initial survey was slightly higher, equipment information was assessed age-specifically. In more recent surveys, a higher proportion of currently employed and fewer retired patients were included. It is noteworthy that the overall health status of patients in the more recent surveys was slightly poorer, and fewer participants from smaller cities were involved. However, these differences in the surveyed populations do not seem significant enough to compromise the essential findings.

Current Utilization of Internet Technologies

In the latest survey, 3-quarters of patients reported active internet usage. Beyond conventional activities such as emailing (81.4%), prevalent internet engagements included reading news (58.2%), online banking (56.5%), participation in private social networks (54.0%), video calls (53.6%), and gathering information on consumer products (50.6%). The most substantial absolute surge in users from 2013 to 2020 was observed in video calls (a 39.3% increase), succeeded by private social networks (a 36.6% increase), and news reading (a 32.7% increase). Notably, the most pronounced relative increase was evident in participation in online courses, with the percentage more than quintupling from 3.1% to 17.3% (refer to Table 2).

Among all patients surveyed, almost 3-quarters already use the internet for health-related topics. While in 2013, 7.2% said that they were using their mobile phone for health-related topics, this figure rose more than sevenfold to 52.3% in 2020. The number of patients using the internet without help increased across surveys for tasks such as seeking general information about their disease, researching information about doctors, exploring other treatment options, and accessing professional scientific information. Although direct contact with doctors, pharmacists, and other patients has also increased significantly and more than doubled in each case, it remains at a low level compared to the other topics. In 2020, for example, 1 in 6 patients stated that they would contact their doctor via the internet. The largest relative increase was seen regard-

Figure 1 Internet access and ownership of internet-enabled devices across different age groups.

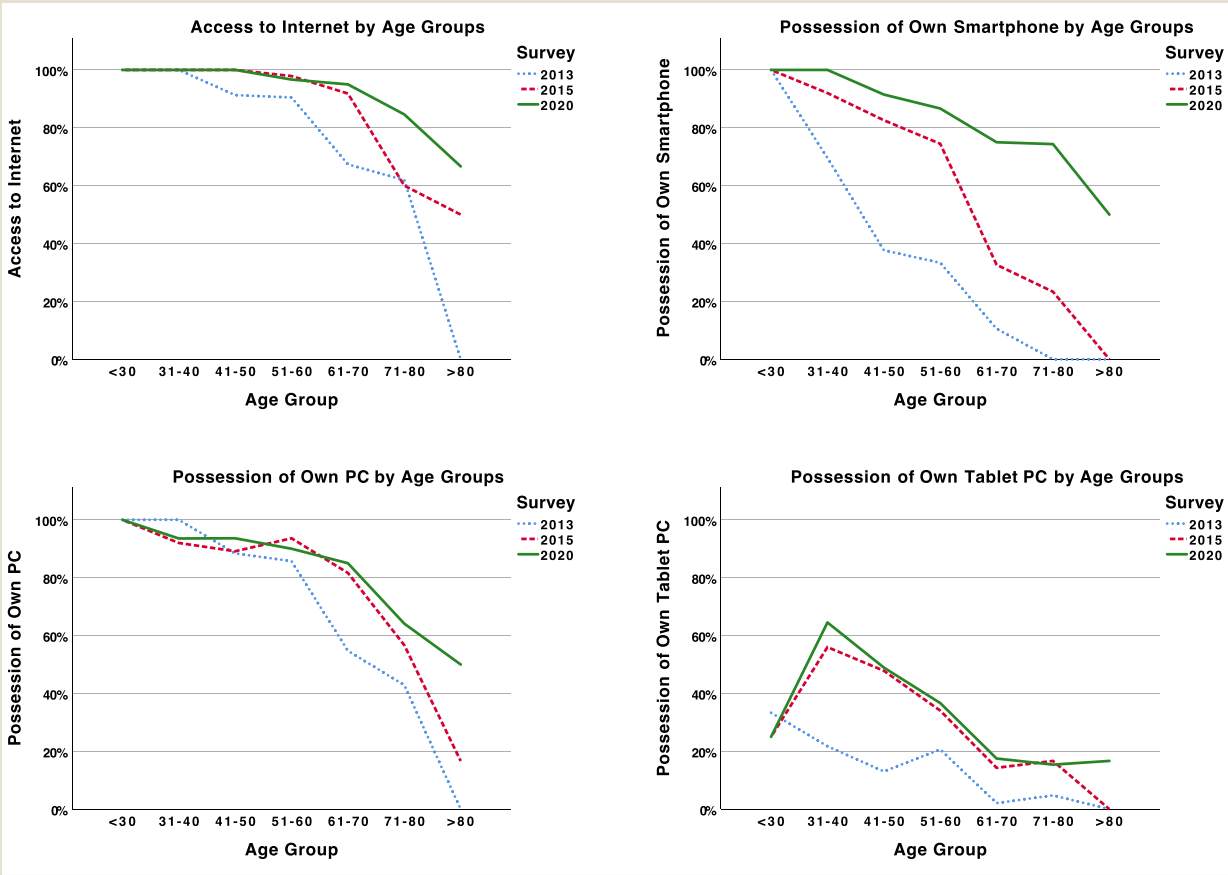


Table 2 Current Usage of Internet Technologies for Nonhealth-Related Topics at the Time of the Surveys

	Total		2013		2016		2020		
	N	% In Column	*N*	% In Column	*N*	% In Column	*N*	% In Column	*P*
Daily use of internet	451	58.6%	151	47.0%	131	62.1%	169	71.3%	.001
Writing emails	580	75.4%	219	68.2%	168	79.6%	193	81.4%	<.01
Private social networks	246	32.0%	56	17.4%	62	29.4%	128	54.0%	<.01
Job-related social networks	98	12.7%	20	6.2%	22	10.4%	56	23.6%	<.01
Video calls	217	28.2%	46	14.3%	44	20.9%	127	53.6%	<.01
Read news	306	39.8%	82	25.5%	86	40.8%	138	58.2%	<.01
Information on education	161	20.9%	51	15.9%	43	20.4%	67	28.3%	.014
Participation in online courses	62	8.1%	10	3.1%	11	5.2%	41	17.3%	<.01
Job search and applications	85	11.1%	22	6.9%	22	10.4%	41	17.3%	.003
Use of online encyclopedias	256	33.3%	77	24.0%	77	36.5%	102	43.0%	<.01
Information on products	336	43.7%	116	36.1%	100	47.4%	120	50.6%	.004
Use of travel services	266	34.6%	92	28.7%	68	32.2%	106	44.7%	.004
Online banking	340	44.2%	111	34.6%	95	45.0%	134	56.5%	<.01
Sale of goods and services	164	21.3%	43	13.4%	41	19.4%	80	33.8%	<.01

Table 3 Current Usage of Internet Technologies for Health-Related Topics at the Time of the Surveys

	Total		2013		2016		2020		
	N	% In Column	*N*	% In Column	*N*	% In Column	*N*	% In Column	*P*
Usage of internet for health-related topics	559	72.7%	212	66.0%	165	78.2%	182	76.8%	.023
Usage of mobile phone for health-related topics	183	23.8%	23	7.2%	36	17.1%	124	52.3%	<.01
Using the internet without help	505	65.7%	182	56.7%	148	70.1%	175	73.8%	.011
General information about the disease	502	65.3%	185	57.6%	148	70.1%	169	71.3%	<.01
Search for information about doctors	390	50.7%	129	40.2%	119	56.4%	142	59.9%	<.01
Direct contact to doctor	86	11.2%	25	7.8%	22	10.4%	39	16.5%	.007
Direct contact to pharmacists	25	3.3%	7	2.2%	5	2.4%	13	5.5%	.091
Exchange with other patients	94	12.2%	20	6.2%	21	10.0%	53	22.4%	<.01
Search for other treatment options	251	32.6%	96	29.9%	73	34.6%	82	34.6%	.047
Professional scientific information	279	36.3%	90	28.0%	82	38.9%	107	45.1%	<.01

ing patients who communicate with other patients via the internet; this percentage more than tripled from 6.2% to 22.4% (Table 3).

We observed a significant negative correlation between increasing age and current use of internet for health-related topics ($P < .001$). This trend extends to nearly all aspects of internet usage, including direct contact with doctors ($P < .01$), as well as nonhealth-related activities such as online banking ($P < .001$) and social networks ($P < .001$).

Personal Attitude and Future Expectations Regarding Digital Therapy Support

We examined the evolution of individuals' perspectives and expectations regarding digital therapy support, exploring shifts in patient attitudes before and during the COVID-19 pandemic by comparing their views on eHealth from 2013/2016 to 2020.

Notably, in the surveys conducted prior to the COVID-19 pandemic (2013, 2016), patients tended to express a neutral stance towards utilizing the internet for health-related topics (mean 0.25) and documenting side effects online (mean -0.31) on a scale ranging from -2 (strongly disagree) to +2 (strongly agree). However, in the spring of 2020, responses reflected a more positive outlook, with respondents exhibiting favorability towards both scenarios (internet use for health-related topics: mean 0.74; documentation of side effects: 0.49; Figure 2).

Furthermore, there was a significant shift from initial reluctance towards using smartphones for health-related matters (mean -0.92 before COVID-19) and documenting side effects through these devices (mean -1.21 before COVID-19) to a positive acceptance post-COVID-19 outbreak (smartphone use for health-related topics: 0.54; documentation of side effects using smartphones: 0.43).

Noteworthy is the observation that expectations for digital therapy support showed an upward trend with higher levels of education, except among individuals with doctoral degrees. Specifically, within the groups with the highest educational attainment, the mean scale values increased across all questions, reflecting a positive shift in attitudes, such as the willingness to document therapy side effects via the internet in the future (Figure 3). Moreover, a universal positive correlation between higher education levels and future expectations ($P < .001$) was evident across all respondents.

Discussion

It can be clearly seen that in the 7-years between the 3 surveys, patient characteristics as well as technical equipment and patient attitudes regarding its use have changed considerably. The significant increase in the number of patients with higher education qualifications corresponds to recent developments in Germany.[42] The same applies to the increasing number of patients living in large cities like Munich, which is expected to continue to develop in this way.[43] The increase in the use of therapeutic methods such as oral chemotherapeutic agents and antibody-based therapy reflects current progress in cancer therapy.[44,45] The observed deterioration in general health status and in performing activities of daily life, along with the increase in patients with metastatic breast cancer and those whose first diagnosis was more than 1-year ago across our 3 surveys, cannot be attributed to any specific cause—this may well be a random effect. It is also possible, however, that COVID-19-related caution may have led to certain patient populations postponing their follow-up examination in early 2020.

As expected, availability of internet access and internet-capable devices among young patients was very high. The increasing adoption rate of such devices among older patients was in line with the development observed in other studies.[46,47] The role of smartphones is particularly noteworthy in this context as the observed availability has increased considerably. Moreover, most patients have shifted their opinion on using these devices for health-related issues or for documenting side effects, moving from the lowest rating to the second highest within just 7-years. As a result, special attention should be paid to the development of appropriate interfaces for mobile devices, particularly regarding the specific needs of elderly patients.[48] Although adoption rates for such devices have already

Figure 2 Opinion on future eHealth topics before (2013, 2016) and during the COVID-19 pandemic (2020) on a scale from -2 (strongly disagree) to +2 (strongly agree).

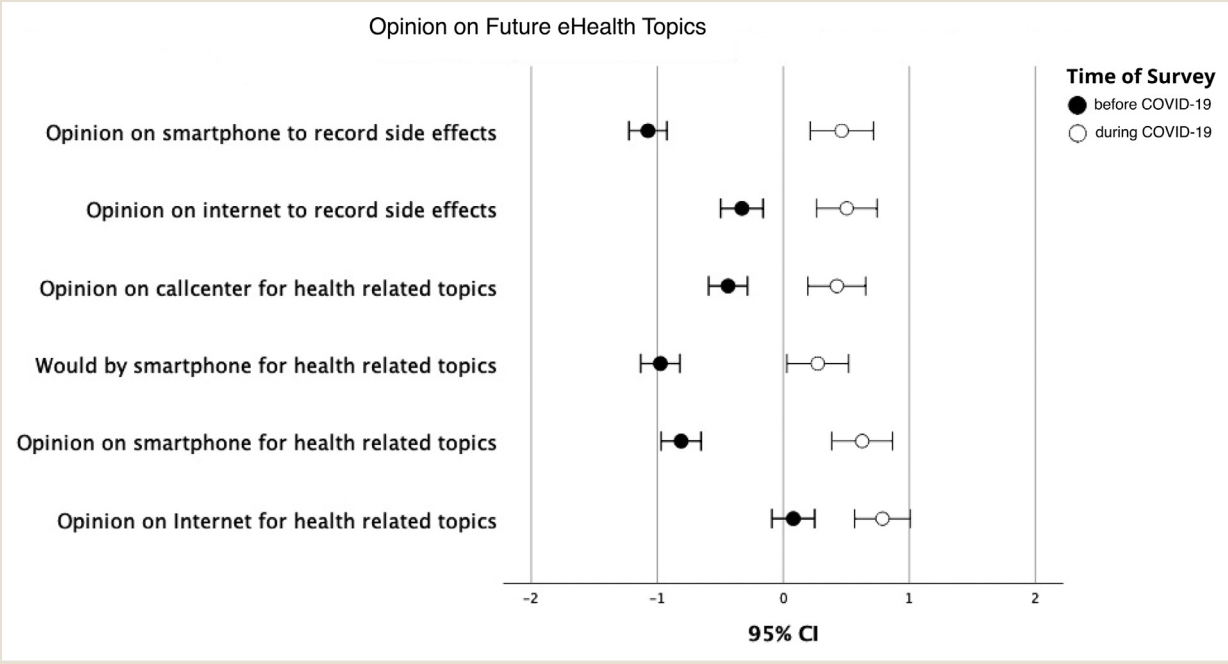
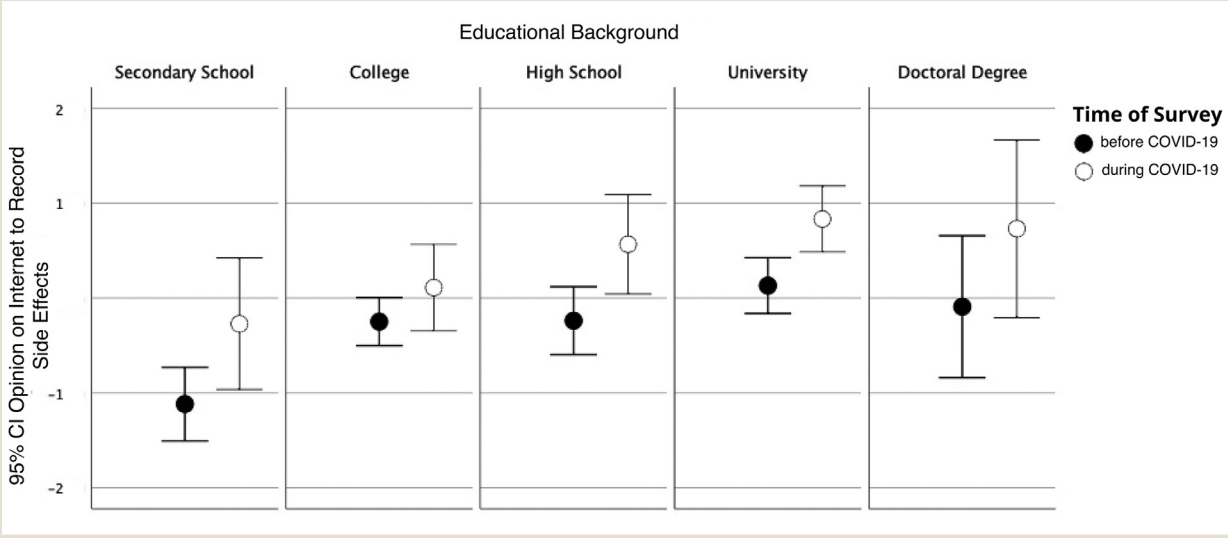


Figure 3 Opinion on the internet to record side effects by educational qualification before (2013, 2016) and during the COVID-19 pandemic (2020) on a scale from -2 (strongly disagree) to +2 (strongly agree).



increased among older patients, a higher age seems to be the decisive factor for both declining current internet use and a more critical or reluctant attitude towards this topic. It may be necessary, for example, to promote further adoption through special education and training as well as through equipment adapted for the elderly. The level of education appears to influence patient enthusiasm towards eHealth solutions, with those having lower school-leaving qualifications showing less enthusiasm. This is also consistent with other studies evaluating the topic of internet access and level of education.[49] Providing targeted information and explanations about the benefits of eHealth may be beneficial to reach this target group.

The trend towards increasing digitization of our society, which has been ongoing for years, was also clearly reflected in the surveys. In the past, the central problem of practical implementation of eHealth applications was the contradiction between the high speed of software development and the long duration of clinical trials.[50] In this context, Keesara et al.[51] describe that the necessary technologies have existed for decades but have not achieved adoption due to stringent regulations and inadequate financial structures. During the COVID-19 pandemic, extensive contact restrictions were imposed in many countries at short notice, and the opening of shops, schools, hospitals, and other facilities became restricted. This historically unique situation reveals not only a necessity but offers a good opportunity to advance digitization in medicine across all age groups, a process that is already ongoing in other areas of everyday life.

There is already evidence that the COVID-19 pandemic seems to accelerate rapid implementation of internet-based interaction possibilities especially in healthcare, highlighting many opportunities for future development strategies.[29,38,52-54] These new achievements would probably not only be effective for future lockdown scenarios but also impact routine patient care. It remains to be seen whether there is now a greater focus on eHealth as a convenient, cost-effective way for patient-healthcare provider interaction, and whether eHealth can improve therapy management and supportive cancer care by recording patient-reported outcomes.[25] The COVID-19 pandemic, therefore, has the potential to become a turning point or at least an accelerator of the digital transformation in the healthcare system.[39]

Appropriate patient-oriented eHealth solutions may even address several issues at the same time. For example, Eccleston et al.[55] describe the potentially positive benefits of rapidly introduced eHealth-based pain management services in terms of emotional distress related to the COVID-19 pandemic. Another new and free web- and app-based patient assessment tool improves care while ensuring safety of patients suffering from COVID-19, supporting healthcare professionals working in the COVID-19 environment.[56]

However, the widespread adoption of internet-based eHealth in routine care does not necessarily guarantee improvement of treatment. Oh et al.[10] already stated that none of the definitions of eHealth they investigated include considerations of potential adverse, negative, harmful, or disadvantageous effects. Particularly with older patients, the widespread use of eHealth and the possibly associated reduction in contacts could lead to further problems such as mental illnesses.[57] Additionally, the introduction of new technologies can inevitably amplify existing disparities due to limited access among patients with lower income, lower socioeconomic status, lower technological literacy, and those residing in rural or remote areas. This effect was recently shown by Griffin et al.[58] among patients having access to an electronic health record-based cancer symptom surveillance and management portal. The digital divide may result in unequal health outcomes and decreased quality of care for these vulnerable populations. An extensive switch to eHealth technologies in combination with the declining population outside of large cities could also lead to a reduction of local expertise in rural areas, which could further exacerbate this development. Upcoming studies will demonstrate whether these or other postulated negative effects do occur in practice and will eventually provide strategies to address them.

On the positive side, several recent studies have already demonstrated a reduction in symptom burden or other beneficial effects in patients using ePROs integrated into the electronic patient record. For example, Hassett et al.[59] developed eSyM, an ePRO-based symptom management program integrated into the electronic patient record. Patients starting chemotherapy or undergoing surgery, eg, for suspected gynecologic cancer, who completed a symptom questionnaire were offered additional support. The utilization of eSyM reduced the risk of an emergency room admission or hospitalization. Kolodziej et al.[60] showed that patients diagnosed with breast, lung, or colon cancer who used ePROs self-reported more symptoms compared to those who reported symptoms through patient-initiated phone calls to nurses, while the need for a visit in acute care was the same in both groups. The authors assume that this could be attributed to electronic reporting, which allows patients to easily share their symptoms with healthcare providers and obtain immediate assistance. As a final example, the PRO-DUCE study demonstrated how monitoring using ePROs compared to routine follow-up could improve the quality of life for patients receiving trastuzumab deruxtecan treatment for metastatic breast cancer.[61]

Future research should focus on evaluating the long-term effects of eHealth interventions on patient outcomes through longitudinal studies. Investigating practical implementation challenges and developing strategies to facilitate eHealth adoption in clinical practice is crucial. The integration of ePROs into eHealth platforms should be explored further to provide real-time feedback for adaptive care. Personalized eHealth interventions using AI and machine learning (ML) should be developed to tailor treatments to individual patient needs. It must be investigated whether inequality, particularly among the described vulnerable groups, exists and how it can be prevented. Additionally, regulatory and ethical considerations, including patient privacy and data security, need to be examined.

To apply eHealth effectively to patient care, it is crucial to implement training programs for both patients and healthcare providers. These programs will enhance digital literacy and ensure the effective use of eHealth tools. Additionally, developing user-friendly and affordable eHealth solutions is essential to address issues of equity and access, ensuring that all populations can benefit. Clinical trials should be conducted to evaluate the efficacy of specific eHealth interventions in improving clinical outcomes. Furthermore, integrating ePROs will facilitate timely and responsive care, enabling healthcare providers to make informed decisions based on real-time patient data. It is also important to discover how other recent advancements in AI and ML can be validated and implemented in clinical practice.

Several limitations of this patient survey should also be considered. The voluntary nature of participation may introduce a representation bias, potentially favoring patients more inclined to engage, and thus marginalizing essential insights from key patient subsets. Moreover, it is noteworthy that a considerable percentage of respondents indicated an elevated educational status. Consequently, the interpretations may predominantly mirror the experiences and views

of this subset, potentially not generalizing to the broader population, especially those with varied educational backgrounds. The survey's commencement around the onset of the pandemic, combined with the dynamic nature of the disease's progression and rapid transitions in healthcare methodologies, suggests that the derived insights may not fully encapsulate prevailing post-pandemic perceptions. Continual assessments are crucial to ensure contemporary relevance and an accurate reflection of the shifting landscape.

Conclusion

Our surveys reveal that crucial prerequisites for digital therapy support are notably present among breast cancer patients. The accessibility of necessary equipment for utilizing eHealth applications is robust, even among older patients. Patient expectations towards eHealth and their openness to receiving therapy support through digital interventions are positive and have exhibited an upward trajectory in recent years. The increased availability of smartphones, coupled with a growing willingness to employ them for health-related concerns, marks a significant shift since 2013 and is poised to shape future developments in this domain.

The next phase of investigation should focus on determining whether this readiness translates into active utilization, and whether the COVID-19 pandemic serves as a tipping point for the widespread adoption of eHealth applications. Furthermore, it is essential to explore whether such tools can enhance supportive cancer care or even positively impact clinical parameters, such as quality of life, to fully understand their potential benefits in the context of breast cancer patient care.

Clinical Practice Points

- *What Is Already Known About This Subject?*
  The potential of eHealth in enhancing patient care and satisfaction, particularly in oncology, has been established. Despite its recognized benefits, the integration of eHealth into routine cancer patient management has been a gradual process. The COVID-19 pandemic, characterized by social distancing and lockdown measures, has significantly impacted cancer patients, prompting a shift towards digital healthcare solutions.
- *What Are the New Findings?*
  Our study, encompassing 959 breast cancer patients surveyed in 2013, 2016, and 2020, highlights a substantial increase in internet access and ownership of digital devices among these patients. Most notably, there has been a discernible shift in patients' attitudes towards eHealth, transitioning from a neutral standpoint to predominantly positive. This transformation gained particular significance during the COVID-19 pandemic, a period marked by the rapid emergence and widespread adoption of various digital health platforms.
- *How Might It Impact Clinical Practice in the Foreseeable Future?*
  The findings suggest a growing readiness among breast cancer patients for the integration of eHealth. Clinicians and healthcare systems should acknowledge and actively incorporate digital therapy support into routine cancer care. This entails utilizing online resources for patient education, implementing remote monitoring, and employing digital communication tools for patient-clinician interactions. The increasing receptiveness to eHealth among patients can facilitate more personalized, efficient, and accessible care, potentially enhancing outcomes and patient satisfaction in the era of digital medicine. Therefore, healthcare providers are encouraged to develop and adopt eHealth strategies tailored to the evolving needs and capabilities of their patient populations.

Disclosure

The authors declare that they have no conflicts of interest. This research was conducted in the absence of any financial and personal relationships that could be construed as a potential conflict of interest.

CRediT authorship contribution statement

Florian Schindler: Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Rachel Wuerstlein:** Writing – review & editing, Investigation. **Timo Schinkoethe:** Writing – review & editing, Validation, Methodology, Formal analysis, Conceptualization. **Anna M. Debes:** Writing – review & editing, Investigation. **Caroline Paysen:** Writing – review & editing, Methodology, Conceptualization. **Nadia Harbeck:** Writing – review & editing, Supervision. **Tanja K. Eggersmann:** Writing – original draft, Supervision, Project administration, Methodology, Investigation, Formal analysis, Conceptualization.

Acknowledgments

We express our sincere gratitude to all the patients who generously participated in these surveys, as well as to the dedicated nurses and physicians whose invaluable support contributed to the success of this research. This research did not receive any specific grants from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. WHO. Weekly Epidemiological Update 10 November 2020; https://www.who.int/docs/default-source/coronaviruse/situation-reports/20201110-weekly-epi-update-13.pdf, 2020 (Accessed December 2, 2023).
2. Elective surgery cancellations due to the COVID-19 pandemic: global predictive modelling to inform surgical recovery plans. *Br J Surg*. 2020;107(11):1440–1449. doi:10.1002/bjs.11746.
3. Hanna TP, King WD, Thibodeau S, et al. Mortality due to cancer treatment delay: systematic review and meta-analysis. *BMJ*. 2020;371:m4087.
4. Maringe C, Spicer J, Morris M, et al. The impact of the COVID-19 pandemic on cancer deaths due to delays in diagnosis in England, UK: a national, population-based, modelling study. *Lancet Oncol*. 2020;21(8):1023–1034. doi:10.1016/S1470-2045(20)30388-0.
5. Dowsett M, Ellis MJ, Dixon JM, et al. Evidence-based guidelines for managing patients with primary ER+ HER2− breast cancer deferred from surgery due to the COVID-19 pandemic. *NPJ Breast Cancer*. 2020;6(1):21. doi:10.1038/s41523-020-0168-9.
6. Guan WJ, Ni ZY, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med*. 2020;382(18):1708–1720. doi:10.1056/nejmoa200203.
7. Mehta V, Goel S, Kabarriti R, et al. Case fatality rate of cancer patients WITH COVID-19 in a New York hospital system. *Cancer Discov*. 2020;10(7):935–941. doi:10.1158/2159-8290.CD-20-0516.
8. Liang W, Guan W, Chen R, et al. Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China. *Lancet Oncol*. 2020;21(3):335–337. doi:10.1016/S1470-2045(20)30096-6.
9. Li R, Pei S, Chen B, et al. Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV-2). *Science*. 2020;368(6490):489–493. doi:10.1126/science.abb3221.
10. Oh H, Rizo C, Enkin M, Jadad A. What is eHealth (3): a systematic review of published definitions. *J Med Internet Res*. 2005;7(1):1–12. doi:10.2196/jmir.7.1.e1.

11. Eysenbach G. What is e-health? *J Med Internet Res*. 2001;3(2):1–5. doi:10.2196/jmir.3.2.e20.
12. Mohsen K, Kildea J, Lambert SD, Laizner AM. Exploring cancer patients' perceptions of accessing and experience with using the educational material in the opal patient portal. *Support Care Cancer*. 2021;29(8):4365–4374. doi:10.1007/s00520-020-05900-4.
13. Uslu AM, Stausberg J. Value of the electronic patient record: an analysis of the literature. *J Biomed Inform*. 2008;41(4):675–682. doi:10.1016/j.jbi.2008.02.001.
14. Benjamins J, Haveman-Nies A, Gunnink M, Goudkuil A, De Vet E. How the use of a patient-accessible health record contributes to patient-centered care: scoping review. *J Med Internet Res*. 2021;23(1):e17655. doi:10.2196/17655.
15. Kierkegaard P. E-prescription across Europe. *Health Technol (Berl)*. 2013;3:205–219. doi:10.1007/s12553-012-0037-0.
16. Riis CL, Jensen PT, Bechmann T, Möller S, Coulter A, Steffensen KD. Satisfaction with care and adherence to treatment when using patient reported outcomes to individualize follow-up care for women with early breast cancer–a pilot randomized controlled trial. *Acta Oncol (Madr)*. 2020;59(4):444–452. doi:10.1080/0284186X.2020.1717604.
17. Zheng D, He X. Overview of artificial intelligence in breast cancer medical imaging. *J Clin Med*. 2023;12(2):419. doi:10.3390/jcm12020419.
18. Konttila J, Siira H, Kyngäs H, et al. Healthcare professionals' competence in digitalisation: a systematic review. *J Clin Nurs*. 2019;28(5-6):745–761. doi:10.1111/jocn.14710.
19. Basch E, Deal A, Dueck A, et al. *Overall survival results of a trial assessing patient-reported outcomes for symptom monitoring during routine cancer treatment*; 2017 *JAMA*;318:197–198.
20. Denis F, Lethrosne C, Pourel N, et al. Overall survival in patients with lung cancer using a web-application-guided follow-up compared to standard modalities: results of phase III randomized trial. *J Clin Oncol*. 2016;34(18_suppl):LBA9006. doi:10.1200/JCO.2016.34.18_suppl.LBA9006.
21. Dayer L, Heldenbrand S, Anderson P, Gubbins PO, Martin BC. Smartphone medication adherence apps: potential benefits to patients and providers. *J Am Pharm Assoc (2003)*. 2013;53(2):172–181. doi:10.1331/JAPhA.2013.12202.
22. Bennett AV, Jensen RE, Basch E. Electronic patient-reported outcome systems in oncology clinical practice. *CA Cancer J Clin*. 2012;62(5):336–347. doi:10.3322/caac.21150.
23. Cardoso F, Senkus E, Costa A, et al. 4th ESO-ESMO international consensus guidelines for advanced breast cancer (ABC 4). *Ann Oncol*. 2018;29(8):1634–1657. doi:10.1093/annonc/mdy192.
24. Weingart SN, Brown E, Bach PB, et al. NCCN task force report: oral chemotherapy. *JNCCN J Natl Compr Cancer Network*. 2008;6(S3):S1–S14. doi:10.6004/jnccn.2008.2003.
25. Eggersmann TK, Harbeck N, Schinkoethe T. Riese C. eHealth solutions for therapy management in oncology. *Breast Cancer Manag*. 2017;6(3):101–106. doi:10.2217/bmt-2017-0005.
26. Atkins L, Fallowfield L. Intentional and non-intentional non-adherence to medication amongst breast cancer patients. *Eur J Cancer*. 2006;42(14):2271–2276. doi:10.1016/j.ejca.2006.03.004.
27. Chlebowski RT, Geller ML. Adherence to endocrine therapy for breast cancer. *Oncology*. 2006;71(1-2):1–9. doi:10.1159/000100444.
28. Hershman DL, Shao T, Kushi LH, et al. Early discontinuation and non-adherence to adjuvant hormonal therapy are associated with increased mortality in women with breast cancer. *Breast Cancer Res Treat*. 2011;126(2):529–537. doi:10.1007/s10549-010-1132-4.
29. Bashshur R, Doarn CR, Frenk JM, Kvedar JC, Woolliscroft JO. Telemedicine and the COVID-19 pandemic, lessons for the future. *Telemed J E Health*. 2020;26(5):5–8. doi:10.1089/tmj.2020.29040.rb.
30. Ramirez PT, Chiva L, Eriksson AGZ, et al. COVID-19 global pandemic: options for management of gynecologic cancers. *Int J Gyn Cancer*. 2020;75(7):410–411. doi:10.1136/ijgc-2020-001419.
31. Hollander JE, Carr BG. Virtually Perfect? Telemedicine for Covid-19. *New Engl J Medi.*. 2020;382(18):1679–1681. doi:10.1056/nejmp2003539.
32. Ohannessian R, Duong TA. *Odone A. Global telemedicine implementation and integration within health systems to fight the COVID-19 pandemic: a call to action*; 2020.
33. Onesti CE, Rugo HS, Generali D, et al. Oncological care organisation during COVID-19 outbreak. *ESMO Open*. 2020;5(4):e000853. doi:10.1136/esmoopen-2020-000853.
34. Harky A, Chiu CM, Yau THL, Lai SHD. Cancer patient care during COVID-19. *Cancer Cell*. 2020;37(6):749–750. doi:10.1016/j.ccell.2020.05.006.
35. Vidal-Alaball J, Acosta-Roja R, PastorHernández N, et al. Telemedicine in the face of the COVID-19 pandemic. *Aten Primaria.*. 2020;52(6):418–422. doi:10.1016/j.aprim.2020.04.003.
36. Kijsanayotin B, Pannarunothai S, Speedie SM. Factors influencing health information technology adoption in Thailand's community health centers: applying the UTAUT model. *Int J Med Inform*. 2009;78(6):404–416. doi:10.1016/j.ijmedinf.2008.12.005.
37. Kirkovits T, Schinkoethe T, Drewes C, et al. eHealth in modern patient-caregiver communication: high rate of acceptance among physicians for additional support of breast cancer patients during long-term therapy. *JMIR Cancer*. 2016;2(2):e14. doi:10.2196/cancer.5132.
38. Smith AC, Thomas E, Snoswell CL, et al. Telehealth for global emergencies: implications for coronavirus disease 2019 (COVID-19). *J Telemed Telecare*. 2020;26(5):309–313. doi:10.1177/1357633X20916567.
39. Wind TR, Rijkeboer M, Andersson G, Riper H. The COVID-19 pandemic: the 'black swan' for mental health care and a turning point for e-health. *Internet Interv*. 2020;20:100317. doi:10.1016/j.invent.2020.100317.
40. Drewes C, Kirkovits T, Schiltz D, et al. EHealth acceptance and new media preferences for therapy assistance among breast cancer patients. *JMIR cancer*. 2016;2(2):e5711. doi:10.2196/cancer.5711.
41. Oken MM, Creech RH, Davis TE. Toxicology and response criteria of the Eastern Cooperative Oncology Group. *Am J Clin Oncol: Cancer Clin Trials*. 1982;5(6):649–655. doi:10.1097/00000421-198212000-00014.
42. Hüther O, Krücken G. Quantitative-Structural Configuration and Developments. Higher Education in Germany—Recent Developments in an International Perspective. Higher Education Dynamics. Cham: Springer; 2018. doi:10.1007/978-3-319-61479-3_3.
43. Deschermeier P. Die Großstädte im Wachstumsmodus - stochastische Bevölkerungsprognosen für Berlin, München und Frankfurt am Main bis 2035. IW-Report. http://hdl.handle.net/10419/157200, 2016 (Accessed October 8, 2023).
44. Harbeck N, Gnant M. Breast cancer. *Lancet North Am Ed*. 2017;389(10074):1134–1150. doi:10.1016/S0140-6736(16)31891-8.
45. Harbeck N, Penault-Llorca F, Cortes J, et al. Breast cancer. *Nat Rev Dis Primers*. 2019;5(1):66. doi:10.1038/s41572-019-0111-2.
46. Anderson M, Perrin A. Tech adoption climbs among older adults. Pew Research Center. https://www.pewresearch.org/internet/2017/05/17/tech-adoption-climbs-among-older-adults/, 2017 (Accessed July 7, 2023)
47. Zickuhr K, Madden M Older adults and internet use. Pew Research Center. https://www.pewresearch.org/internet/2012/06/06/main-report-15/, 2012 (Accessed October 9, 2023).
48. Rosales A, Fernández-Ardèvol M. Smartphone Usage Diversity among Older People. In: Sayago S, ed. Perspectives on Human-Computer Interaction Research with Older People. Human–Computer Interaction Series. Cham: Springer; 2019. doi:10.1007/978-3-030-06076-3_4.
49. Korupp SE, Szydlik M. Causes and trends of the digital divide. *Eur Sociol Rev*. 2005;21(4):409–422. doi:10.1093/esr/jci030.
50. Schinköthe T. Individualized eHealth support for oncological therapy management. *Breast Care*. 2019;14(3):130–134. doi:10.1159/000500900.
51. Keesara S, Jonas A, Schulman K. Covid-19 and health care's digital revolution. *N Engl J Med*. 2020;382(23):e82. doi:10.1056/NEJMp2005835.
52. Humphreys J, Schoenherr L, Elia G, et al. Rapid implementation of inpatient telepalliative medicine consultations during COVID-19 Pandemic. *J Pain Symptom Manage.*. 2020;60(1):e54–e59. doi:10.1016/j.jpainsymman.2020.04.001.
53. Annis T, Pleasants S, Hultman G, et al. Rapid implementation of a COVID-19 remote patient monitoring program. *J Am Med Inform Assoc*. 2020;27(8):1326–1330. doi:10.1093/jamia/ocaa097.
54. Reeves JJ, Hollandsworth HM, Torriani FJ, et al. Rapid response to COVID-19: health informatics support for outbreak management in an academic health system. *J Am Med Inform Assoc*. 2020;27(6):853–859. doi:10.1093/jamia/ocaa037.
55. Eccleston C, Blyth FM, Dear BF, et al. Managing patients with chronic pain during the COVID-19 outbreak. *Pain*. 2020;161(5):889–893. doi:10.1097/j.pain.0000000000001885.
56. Schinköthe T, Gabri MR, Mitterer M, et al. A web- and app-based connected care solution for COVID-19 in- and outpatient care: qualitative study and application development. *JMIR Public Health Surveill*. 2020;6(2):e19033. doi:10.2196/19033.
57. Armitage R, Nellums LB. COVID-19 and the consequences of isolating the elderly. *Lancet Public Health*. 2020;5(5):e256. doi:10.1016/S2468-2667(20)30061-X.
58. Griffin JM, Kroner BL, Wong SL, et al. Disparities in electronic health record portal access and use among patients with cancer. *J Natl Cancer Inst*. 2024;116(3):476–484. doi:10.1093/jnci/djad225.
59. Hassett MJ, Uno H, Tramontano A, et al. Efficacy of eSyM: acute care utilization among patients with cancer who do versus do not report ePROs. *J Clin Oncol*. 2024;42(16_suppl):11001 -11001. doi:10.1200/JCO.2024.42.16_suppl.1100.
60. Kolodziej MA, Ascha MS, Frank A, et al. Symptoms reported by patients using an ePRO compared with those reported to nurses via telephone triage. *J Clin Oncol*. 2024;42(16_suppl):1542. doi:10.1200/JCO.2024.42.16_suppl.1542.
61. Kikawa Y, Uemura Y, Taira T, et al. A randomized study comparing electronic patient-reported outcome (ePRO) monitoring with routine follow-up during trastuzumab deruxtecan treatment in patients with metastatic breast cancer (PRODUCE study). *J Clin Oncol*. 2024;42(16_suppl):1542. doi:10.1200/JCO.2024.42.16_suppl.150.